

Measurement Guide

Agilent Technologies E7495A/B

Base Station Test Set

For firmware revision A.04.00 and above



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“Using the Soft Carrying Case” on page 51

“Contacting Agilent Technologies” on page 53

Introduction

The E7495A/B Base Station Test Set is designed to simplify the job of installing and maintaining base stations. By combining all important base station diagnostic tools in one rugged instrument, the E7495A/B lets you get your work done in the shortest time at each base station.

Basic test functionality includes:

- Spectrum Analysis
- Two Port Insertion Loss
- One Port Insertion Loss
- Return Loss
- Distance to Fault

You can optionally add these measurements:

- Adjacent Channel Power
- CDMA Over Air
- CDMA Analyzer
- WCDMA/UMTS Analyzer
- WCDMA/UMTS Over Air
- 1xEV-DO Analyzer
- GSM Analyzer
- Channel Scanner
- T1
- E1
- CW/cdmaOne/cdma2000/1xEV-DO Reverse Link Signal Generator
- Power Meter
- Test software and utilities
- DC Bias output (internal, available on the E7495B only)

In Getting Started, you will learn how to set up the E7495A/B, and you will learn to perform one basic measurement to start getting familiar with the range of tools

contained in the test set.

If you are a new user, also recommended is E7495A Quick Basics, an HTML-based tutorial available on the CD that comes with the test set.

After the Getting Started chapter, you will find, in alphabetical order, one chapter on each E7495A/B measurement. General information on batteries, caring for the E7495A/B, and how to return the instrument for service follows.

Unpacking the E7495A/B Test Set

Unpack and inspect the shipping container and its contents thoroughly to ensure that nothing was damaged during shipment.

If the contents are damaged or defective, contact your nearest Agilent Technologies sales and service office. Keep the shipping materials for the carrier's inspection.

Verify that all the parts were included in the shipping container.

The basic test set package for the E7495A includes:

- E7495A/B Base Station Test Set
- Shoulder strap
- One battery
- Two 10 dB pads
- AC/DC converter
- Two N-to-N barrels
- Open connector (50 Ω)
- Short connector (50 Ω)
- Load connector (50 Ω)
- Two attenuator 10 dB coaxial connectors
- GPS antenna
- 64 MB PCMCIA memory card
- CD ROM containing electronic (PDF) version of Measurement Guide, E7495A Quick Basics tutorial, and application notes
- Base Station Test Set Accessories kit (pn E7495-60044) includes:
 - Accessories case
 - Two 60-centimeter (2-foot) cables
 - One 3-meter (10-foot) cable
 - Two N-to-11 millimeter (N-to-7/16 inch) connectors
 - Soft carrying case

- High power attenuator
- Measurement Guide (this manual)
- Soft carrying case loading card

The standard test set package for the E7495B includes:

- E7495A/B Base Station Test Set
- Shoulder strap
- One battery
- Two 10 dB pads
- AC/DC converter
- Two N-to-N barrels
- Open connector (50 Ω)
- Short connector (50 Ω)
- Load connector (50 Ω)
- Two attenuator 10 dB coaxial connectors
- GPS antenna
- 64 MB PCMCIA memory card
- CD ROM containing electronic (PDF) version of Measurement Guide, E7495A Quick Basics tutorial, and application notes

E7495B-800 Base Station Test Set accessories kit contains, in addition to the standard package:

- Soft carrying case
- One 3-meter (10-foot) cable
- Two 60-centimeter (2-foot) cables
- Two N-to-11 millimeter (N-to-7/16 inch) connectors
- High power attenuator
- Measurement Guide (this manual)
- Soft carrying case loading card

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Unpacking the E7495A/B Test Set

E7495A/B Cables, Connectors, and Accessories

Part Number	Picture	Description
0950-4404		AC/DC adapter 24 VDC 100W
0950-4409		PCMCIA 64MB Flash memory card
0955-1458 (E7495A) 0955-1599 (E7495B)		High power attenuator (40 dB 100W)
1150-2085		GPS antenna, SMA M
1250-2908		Adapter, N (Female) to 11 millimeter (7/16 inch) (Male)

Part Number	Picture	Description
1250-2810		Adapter, N (Female) to 11 millimeter (7/16 inch) (Female)
1420-0883		Battery
8120-8862 Quantity 2		Cable, 60-centimeter (2-ft) N (m) - N (m)
8121-1315		Cable, 3-meter (10-ft) N (m) - N (m)
E7495-20165		Shoulder strap

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 Unpacking the E7495A/B Test Set

Part Number	Picture	Description
E7495-80014		Soft carrying case
E7495-60059	    	<p>Coax Accessories Case, plastic and foam (5000-0911)</p> <p>Open, 50 ohm, N-type male (1250-3421)</p> <p>Short, 50 ohm, N-type male (1250-3424)</p> <p>Load, 50 ohm, N-type male (1250-3423)</p> <p>Attenuator, fixed 6 GHz max 10 dB N type (0955-1534)</p> <p>Adapter, 50 ohm, N-type F-F (1250-3422)</p>

Test set options

Test set part number	Description
E7495A/B, option 200	cdmaOne/cdma 2000 direct connect test, includes: <ul style="list-style-type: none"> CA-ASSY RF 50 ohm, BNC, male to male cable 3-meter (10-ft) (pn 8121-1230)
E7495A/B, option 210	cdmaOne/cdma 2000 over-air test (requires option 200 and 810, 811, or 812)
E7495A/B, option 220	Channel scanner
E7495A/B, option 230	GSM analyzer
E7495A/B, option 240	W-CDMA (UMTS) analyzer
E7495A/B, option 250	W-CDMA OTA analyzer (requires option 240)
E7495A/B, option 270	Interference analyzer
E7495B, option 300	DC bias
E7495B, option 330	Nortel CDMA Base Station Test Software
E7495A/B, option 500	CW signal generator
E7495A/B, option 510	CW/cdmaOne/cdma2000 reverse link signal generator
E7495A/B, option 51B	Return to Agilent repair
E7495A/B, option 50C	Return to Agilent for calibration
E7495A/B, option 600	Power meter (requires 8482A/8481A power sensor), includes: <ul style="list-style-type: none"> One 3-meter (10 ft) power sensor cable (pn E9288-60002)

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Unpacking the E7495A/B Test Set

Test set part number	Description
E7495A/B, option 700	T-1 Analyzer, includes: <ul style="list-style-type: none">• Y-bantams to alligator, 3-meter (10-foot) cable (pn 8121-1026)• Y-bantams to RJ-45, 3-meter (10-foot) cable (pn 8121-1025)• Y-bantams to Y-bantams, 3-meter (10-foot) cable (pn 8121-1024)• Bantam looping cable (quantity 2)
E7495A/B, option 710	E-1 Analyzer, includes: <ul style="list-style-type: none">• Balun, 75 - 120 ohm adapter (0950-4551)• 75 ohm BNC, four connectors, 3-meter (10-foot) cable (quantity 2) (8121-1228)• 75 ohm BNC jumper cable, 100-millimeter (4-inch) length (quantity 2)
E7495B, option 800	Accessories - 100 W 40 dB attenuator, backpack, manual: <ul style="list-style-type: none">• 40 dB attenuator (pn 0955-1599)• soft carrying case (pn E7495-80014)• manual (pn E7495-90031)• soft carrying case loading card (pn E7495-90003)
E7495A/B, option 810	Cellular antenna and pre-selector filter, includes: <ul style="list-style-type: none">• Cellular antenna (pn 1150-2061)• preselector filter (pn 0955-1527)• RF TNC to N connector (pn 1200-1897) for option 210
E7495A/B, option 811	PCS Antenna and pre-selector filter, includes: <ul style="list-style-type: none">• PCS antenna (pn 1150-5059)• preselector filter (pn 0955-1526)• RF TNC to N connector (pn 1200-1897) for option 210

Test set part number	Description
E7495A/B, option 812	<p>Korean PCS Antenna and pre-selector filter, includes:</p> <ul style="list-style-type: none"> • Korean PCS antenna (pn 1150-5059) • preselector filter (pn 0955-1590) • RF TNC to N connector (pn 1200-1897) for option 210
E7495A/B, option 813	<p>European W-CDMA antenna and pre-selector filter, includes:</p> <ul style="list-style-type: none"> • W-CDMA antenna 2.1-2.17 GHz (pn E6455-80003) • preselector filter (pn 0955-1667) • RF TNC to N connector (pn 1200-1897) for option 210
E7495A/B, option 820	<p>External charger/battery pack/DC adapter, includes:</p> <ul style="list-style-type: none"> • Battery 10.8 V 6 A-HR LI-ION (pn 1420-0883) • External power supply AC/DC adapter 24 VDC 100 W (pn 0950-4404) • DC car adapter DC to DC adaptor output 19 VDC 70 W (pn 0950-4412) • dual battery charger, 12 V AT 1 A (pn 0950-4276)
E7495A/B, option 8482	Power Sensor, 100 kHz to 4.2 GHz:
E7495A/B, option 840	Hard transit case (pn E7495-80016)
E7495A/B, option 900	UK power cord
E7495A/B, option 901	AUS/NZ/CH power cord
E7495A/B, option 902	Euro power cord
E7495A/B, option 903	US power cord
E7495A/B, option 906	Swiss power cord
E7495A/B, option 912	Denmark power cord

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Unpacking the E7495A/B Test Set

Test set part number	Description
E7495A/B, option 917	So Af/India power cord
E7495A/B, option 918	Japan power cord
E7495A/B, option 919	Israel power cord
E7495A/B, option 920	Argentinean power cord
E7495A/B, option 921	Chilean power cord
E7495A/B, option 922	China power cord
E7495A/B, option 927	Thailand power cord

For instructions on how to upgrade your analyzer, please see [“Installing an Option” on page 518](#).

Your First 15 Minutes with the E7495A/B

Spend 15 minutes getting acquainted with the test set:

- “Get to Know the Layout of the E7495A/B” on page 44
- “Install a Battery” on page 47
- “Practice Using the Three-way Power Button” on page 47
- “Make Your First Measurement (Two Port Insertion Loss)” on page 48

Your E7495A/B analyzer is fitted with a transfective screen, which is viewable under all lighting conditions. If you are using your E7495A/B analyzer in bright lighting conditions, for example, in direct sunlight, avoid the temptation to shield the display from the sunlight. In bright lighting conditions, the display is brighter and easier to read when you allow the light to fall directly on the screen.

CAUTION

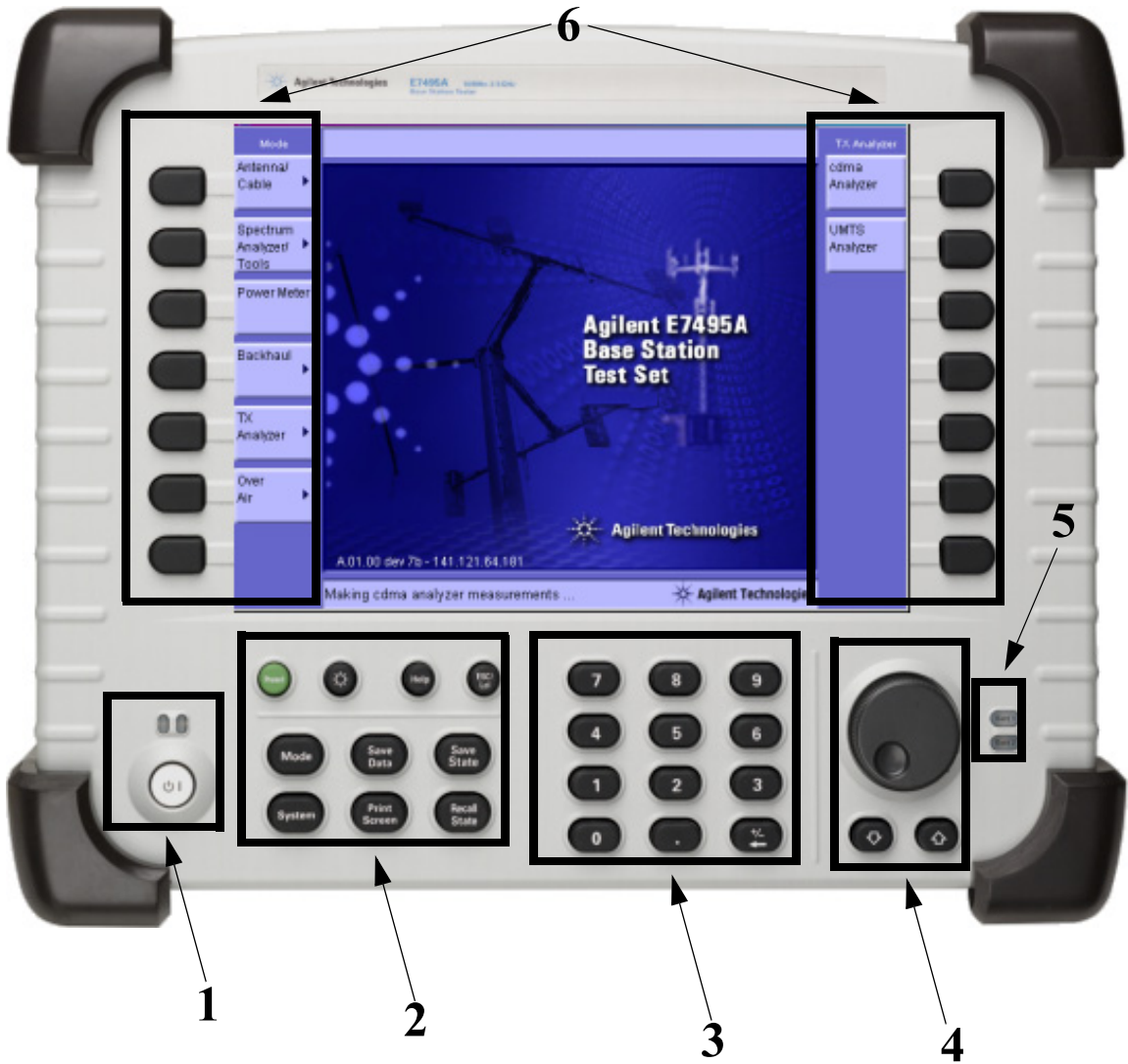
The maximum power for the RF In and RF Out/SWR port is 20 dBm (100 mW). The maximum power for the Power Sensor port is 24 dBm (300 mW). When directly coupled to a base station, the test set can be damaged by excessive power applied to any of these three ports.

To prevent damage in most situations when you directly couple the test set to a base station, use the high power attenuator between the test set and the BTS.

Getting Started
Your First 15 Minutes with the E7495A/B

Get to Know the Layout of the E7495A/B

Getting Started



Number	Description
1	<p>Power button. Powers the test set on and off, and puts it into standby mode.</p> <ul style="list-style-type: none"><li>• To power on, press the power button. When the test set is on, the right LED is lit.<li>• To put into standby mode while the power is on, press the button for about 1 second. In standby mode—which conserves the battery and provides quicker startup—the left LED is lit. For more information about the power button states, refer to “Practice Using the Three-way Power Button” on page 47.<li>• To power off, press the button and hold down until you see both LEDs go out. This takes approximately 5 seconds.
2	<ul style="list-style-type: none"><li>• Preset. Recalls the power-up state, applying Agilent defaults or the defaults you define using the Save State button.<li>• Brightness. Changes the brightness of the display in four increments. To increase or decrease the brightness, press the button repeatedly.<li>• Help. Displays online help.<li>• ESC/Lcl. Stops the active function and clears the active function text from the display. Pressing ESC/Lcl after the test set has been placed in remote mode switches to local mode and enables front-panel control.<li>• Mode. Displays a menu of measurement modes.<li>• Save Data. Saves the non-trace measurement data to either a PCMCIA or CompactFlash card.<li>• Save State. Saves the state of all measurement parameters to non-volatile memory in the test set. You can save multiple states, each with its own name.<li>• System. Displays menu of non-measurement operations including configuration, system status updates, data manipulation, and basic system functions testing.<li>• Print Screen. Prints the current screen image to either a PCMCIA or CompactFlash card.<li>• Recall State. Recalls the state of all measurement parameters you saved in non-volatile memory using the Save State button.
3	<p>Numeric keypad. Used for entry of values for many test parameters.</p>

Number	Description
4	<ul style="list-style-type: none">• Rotary knob. Allows incremental changes to values for such things as carrier frequency, reference level, and marker positions. Rotate clockwise to increase values, counterclockwise to decrease values. The speed at which you turn the knob affects the rate at which the values are changed.• Down Arrow. Decreases the active function value. The increment size depends upon the current measurement. Each press results in a single increment change. For those parameters with fixed values, the next value in a sequence is selected each time you press the button.• Up Arrow. Increases the active function value.
5	Battery LEDs. Show remaining charge capacity and charging status of batteries. For details, see “Viewing Battery Status” on page 557 .
6	menu keys. Allow you to select measurement modes and other settings for configuring and performing measurements, and for other E7495A/B functions.

Install a Battery



Step	Notes
1 Open the battery door.	Turn the latch counterclockwise several times until loose. Then pull the battery door open.
2 Insert the battery.	Insert one or two batteries.
3 Close the battery door.	Turn the latch clockwise until tight to secure the battery door.

For more information about the batteries, including battery installation and removal, refer to [Chapter 22](#), “Working with Batteries.”

Practice Using the Three-way Power Button

The E7495A/B Test Set power button is designed to provide additional convenience when you want to pause between measurements, then quickly start again. Besides

Getting Started

Your First 15 Minutes with the E7495A/B

working like a standard on-off button, the E7495A/B power button also lets you put the test set into standby mode, which conserves battery usage and provides a quick startup when you are ready to resume measurements.

Step	Notes
To power on the test set, press the button.	As soon as you press the power button, the right LED goes on. The full power-up sequence can take up to 2 minutes.
To put the test set into standby mode while the power is on, press the button briefly for about a second.	When in standby mode, the left LED is lit. When you power on the test set again, the startup takes only about 30 seconds.
To power off the test set, press the button and hold until both LEDs above the button go off. This usually takes about 5 seconds.	When you hold down the button, at first both LEDs are lit. After about 5 seconds, both go out.

Make Your First Measurement (Two Port Insertion Loss)

The two port insertion loss measurement is perhaps the most fundamental test set measurement. It quantifies exactly how much loss is incurred as a signal travels through a cable or other device. You must account for the signal loss of a connecting cable in order to produce accurate results for a variety of other measurements.

You can perform this measurement anywhere using these devices (all provided with the E7495A and provided as part of option 800 for the E7495B):

Needed for normalization:

- 60-centimeter (2-foot) normalization jumper cable
- Two 10 dB pads

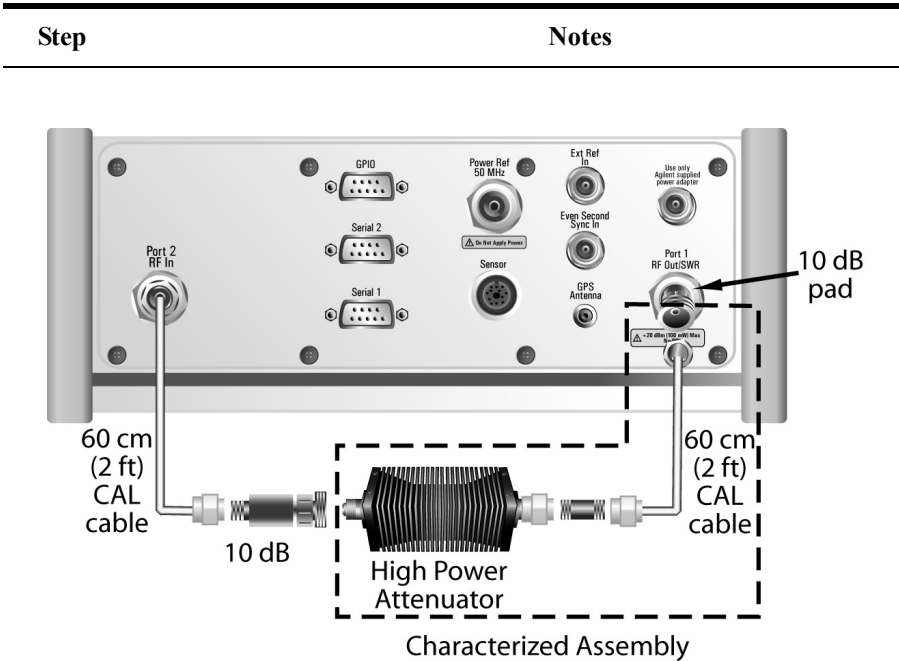
Devices whose insertion loss you measure:

- 60-centimeter (2-foot) test cable
- 3-meter (10-foot) test cable
- High power attenuator
- N-N barrel

Step	Notes
1 Select two port insertion loss. a. Mode b. [Antenna/Cable] c. [Two Port Insertion Loss]	In this and other procedures, front-panel buttons are indicated with bold text, menu keys with brackets.
2 Enter the start frequency. a. Press [Start Freq] if the menu key is not already highlighted. b. Enter the frequency using the numeric keypad. c. Press [Hz], [kHz], [MHz], or [GHz].	
3 Enter the stop frequency. a. Press [Stop Freq]. b. Enter the frequency using the numeric keypad. c. Press [Hz], [kHz], [MHz], or [GHz].	
4 Normalize the test set. a. [Normalize] b. Follow the Normalize Wizard.	The Normalize Wizard, which is built into the test set, displays instructions to guide you through normalization.
5 Attach the device whose insertion loss you want to measure between the two 10 dB pads.	

Getting Started

Your First 15 Minutes with the E7495A/B



Insertion loss measurement of high power attenuator and cable.

For more information on making insertion loss measurements, see [“Two Port Insertion Loss”](#) on page 55.

Using the Soft Carrying Case

The E7495A/B soft carrying case is ergonomically designed to hold the test set as well as its cables and accessories. The soft carrying case allows you to carry all your gear up to a base station while keeping your hands free.



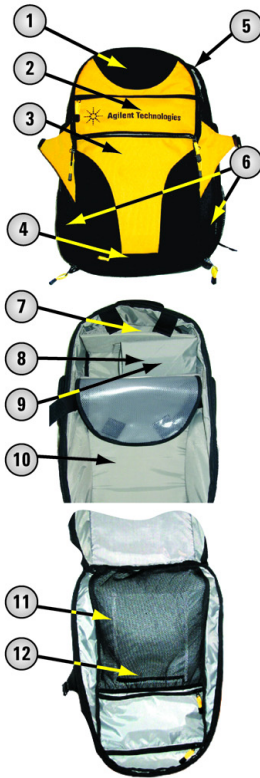
WARNING

To avoid overheating, always disconnect the test set from the AC adapter before storing the test set in the soft carrying case.

If you prefer to leave the test set connected to the AC adapter while inside the soft carrying case, you can disconnect the AC adapter from its power source to prevent overheating.

Getting Started Using the Soft Carrying Case

What Goes Where in the Soft Carrying Case



Business card



Writing supplies



Fragile equipment,
such as antennas



Rain fly



Laptop



Food and water



Over-air filter and
other accessories



High power
attenuator



AC adapter



Base station test set



Cables



Batteries



Slide harness up or down
to fit torso. Don't expose
red stitch line.

CAUTION: A fully loaded backpack is heavy. Use caution when putting it on or taking it off.

Contacting Agilent Technologies

For help with product selection and configuration, technical and application assistance, consulting and integration services, rental and leasing options, refurbished equipment, product purchases, repair, calibration, education and training please go to <http://www.agilent.com/find/assist>

If you do not have access to the Internet, call the appropriate number shown in below or contact your local Agilent Technologies Sales and Service Office.

Americas +1-800-829-4444

Australia +1-800-629-485

Europe, Africa, Middle East +32 (0)2 404-9340

Singapore +1-800-375-8100

More Information from Agilent

For more information about Agilent's E7495A/B Base Station Test Set, go to <http://www.agilent.com/find/e7495b>

For more information about Agilent's solutions for the communications industry, visit our web site at <http://www.agilent.com/comms/industry>

E7495A/B Base Station Test Set Product Updates

For information about E7495A/B Base Station Test Set updates, go to <http://www.agilent.com/find/e7495b>

Getting Started
Contacting Agilent Technologies

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“Performing a Basic Two Port Insertion Loss Measurement (Normalize)” on page 57

“Displaying Location Information Using GPS” on page 58

“Setting Average, Sweep, and Restart” on page 59

“Adding a Marker” on page 62

“Measuring Two Port Insertion Loss for Spectrum Analyzer, Channel Scanner, 1xEV-DO Analyzer, CDMA Analyzer, and Signal Generator (RF In Loss and RF Out Loss)” on page 63

“Measuring Insertion Loss for Power Meter (Option 600 Only)” on page 66

“Determining The Lowest (Worst) Insertion Loss and Its Frequency” on page 67

“Determining the Highest (Best) Insertion Loss and Its Frequency” on page 68

“Using the Delta Marker to Measure a Difference in Insertion Loss or Frequency” on page 68

“Activating Interference Rejection” on page 68

“Clearing Normalization” on page 69

“Setting Source Level” on page 69

“Optimizing Dynamic Range” on page 70

“Setting the Pass/Fail Limits” on page 71

Measuring Two Port Insertion Loss

This test measures the loss of a cable or other device over a specified frequency range.

Insertion loss measurements are important in accurately quantifying the amount of loss a signal will incur as it passes through a cable, attenuator, or any other device. In S-parameter terms, insertion loss is referred to as an S_{21} measurement. “S” stands for scattering.

NOTE

Any cable added to your measurement configuration will add some loss that must be accounted for. For example, a jumper cable placed between the test set and the antenna feedline (or other device) you are connecting will add some loss to the measurement.

If you add a jumper cable to your measurement configuration, you must normalize out the loss associated with the cable at your current measurement frequency. Otherwise, your measurement results will be inaccurate, and you will probably adjust transmit parameters in error.

Insertion loss measurements have a variety of uses. However, the example procedures focus on two kinds of two-port insertion loss measurements that you need as preparation for other test set measurements:

- Measuring the 3 meter (10 ft) test cable, 60 cm (2 ft) normalization cable, and high power attenuator provides values you can store as RF In Loss and RF Out Loss.
 - RF In Loss is used with the Spectrum Analyzer, Channel Scanner, cdma Analyzer, cdma2000 analyzer, 1x-EVDO Analyzer, and the GSM Analyzer.
 - RF Out Loss is used with the Signal Generator.
 - RF Out Loss is the measured loss of cables and other devices between the E7495A/B RF Out (Port 1) and the receiver under test.
- Measuring the high power attenuator and 60 cm (2 ft) normalization cable provides stored Power Meter Loss (PM loss), which is needed for using the Power Meter.
 - PM loss is the measured loss of cables and other devices between the signal source and the power sensor.

Normalizing and Performing a Basic Two Port Insertion Loss Measurement

Before you perform a two port insertion loss measurement, you must first normalize the measured values for insertion loss by compensating for the loss associated with the devices (adapters, cables) that connect the E7495A/B Base Station Test Set to the device or assembly being tested. Otherwise, the loss introduced by these connecting devices is added to the loss of the device under test.

Performing a Basic Two Port Insertion Loss Measurement (Normalize)

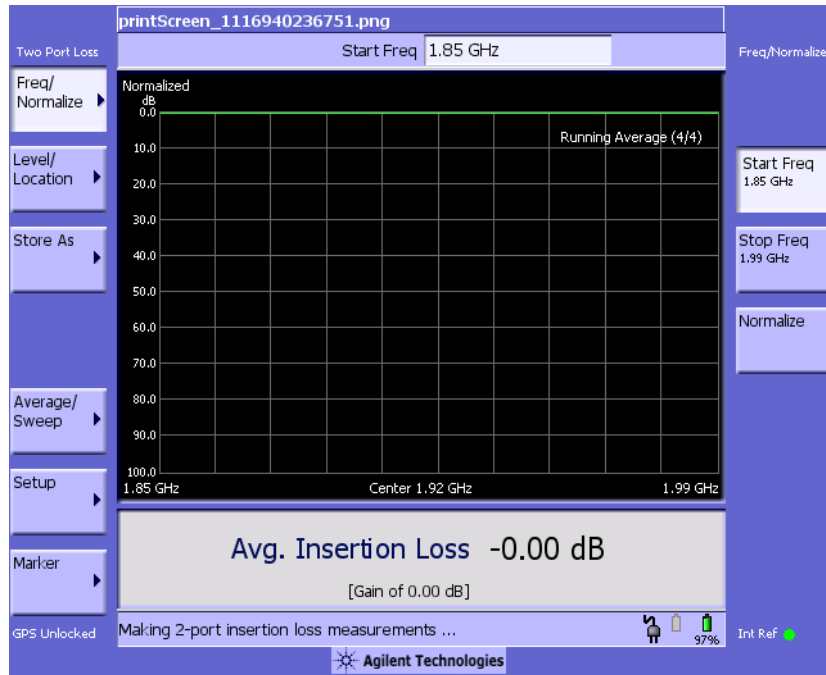
Step	Notes
1	Mode
2	[Antenna/Cable]
3	[Two Port Insertion Loss] The insertion loss measurement takes a few seconds to load.
4	[Start Freq]
5	Enter the start frequency of interest using the numeric keypad.
6	[Hz], [kHz], [MHz], or [GHz]
7	[Stop Freq]
8	Enter the stop frequency of interest using the numeric keypad. The stop frequency should be larger than the start frequency.
9	[Hz], [kHz], [MHz], or [GHz]
10	[Normalize] Follow the instructions of the Normalize Wizard.
11	Connect the device whose insertion loss you want to measure.

Two Port Insertion Loss

Two Port Insertion Loss Measuring Two Port Insertion Loss

Figure 2-1

Two Port Insertion Loss Measurement Results, After Normalization.



Displaying Location Information Using GPS

If you are making a Two Port Insertion Loss measurement, you may use GPS Location data to verify your location. For additional information on the GPS Data function, refer to “[Displaying GPS Location Data](#)” on page 496

To Display GPS Location Information:

Step	Notes
1	[Level/Location]

Step	Notes
2 On [GPS Location] select On .	Displays GPS satellite location information. Uses the internal GPS to capture the location of a measurement. The GPS information can be used to return to the same location. The Time Ref (Freq/Chan/Time Ref mode) button must be set to Internal GPS for this function to be active. Information logged includes latitude, altitude (feet/meters), and the number of satellites tracked. Each time you press this softkey, the selected option changes.
3 Highlight [On]	Toggle to [On] to display GPS satellite location information. Toggle to [Off] to remove the location information

NOTE

If you prefer to have an electronic copy of the location information, see [“Saving Data” on page 503](#).

Setting Average, Sweep, and Restart

Setting the Sweep

You can select either continuous or single sweep. Continuous sweep provides repeated, ongoing measurements. Single sweep performs a single measurement that is repeated only when you push the Single button.

To set sweep:

Step	Notes
1 [Average/Sweep]	
2 [Continuous] or [Single]	Each time you press this softkey, the selected option changes.

Setting Averaging

You can choose to have Averaging On or Off, and to set the number of averages you

Two Port Insertion Loss

Two Port Insertion Loss

Measuring Two Port Insertion Loss

want to take if Averaging is On. Averaging only applies to the data, not to the trace. You can select from the following types of averaging:

- **Off:** Disables averaging.
- **Running:** Computes the new result as the weighted sum of the last result and the new measurement. The last result is weighted by $(n - 1)/n$. The new result is weighted by $1/n$. Each new measurement produces a new result.
- **Max Hold:** Is not an average, but on a point by point basis, displays the maximum amplitude for the given frequency since Max Hold was turned on. It is updated when a new maximum occurs.
- **Group Average:** Makes the requested number of measurements, averages the measurement data, and displays the average as a single result trace. Measurement time will vary based on the requested number of averages, and can take several minutes for very large number of averages.
- **Group Max Average:** Makes the requested number of measurements before returning a single trace result. This trace is the maximum value seen at each trace point over the requested number of averages (measurements).

To set averaging:

Step	Notes
1	Set the number of averages. <ol style="list-style-type: none">[Average]Enter the number of averages using the numeric keypad.[Enter]
2	Select the type of averaging you want to apply. <ol style="list-style-type: none">[Average/Sweep][Averaging][Off], [Running Average], [Max Hold], [Group Average], or [Group Max Average]

NOTE

These two steps can be performed in any order. However, if you turn averaging on and a large number of averages has previously been set, there may be a delay before you can change number of averages.

Setting Restart

When you have averaging turned **On** and you are in **Continuous** Sweep mode, you can restart the averaging by pressing the Restart menu key. The Restart key has no effect if you are in **Single** sweep mode.

NOTE

Pressing the Restart key has no effect on the average count when performing Group Average or Group Max.

To restart averaging:

Step	Notes
1 [Average/Sweep]	
2 [Restart]	This key is unavailable or has no effect when Sweep is set to Single . To restart a Single Sweep measurement, press [Single].

Two Port Insertion Loss

Measuring Two Port Insertion Loss

Adding a Marker

Markers can be used on traces to help you visually track up to four signals. Each marker has the following settings:

- **Type:** Provides three options, including:
 - **Off**
 - **Normal:** Places a diamond-shaped, colored marker, along with a number, 1-4, on the trace.
 - **Delta:** This is associated with a normal marker. Therefore, a normal marker must exist prior to creating the delta marker. The delta marker displays the difference between the normal marker position and the delta marker position. Only one delta marker can be associated with a given normal marker. The normal marker must be active when Delta is selected.
- **Marker to Peak:** Places the active marker on the current greatest value of the trace.
- **Marker to Next Peak:** Places the active marker on the current second greatest value of the trace.
- **Marker to Min:** Places the active marker on the current lowest value of the trace.
- **Marker to Next Min:** Places the active marker on the current second lowest value of the trace.

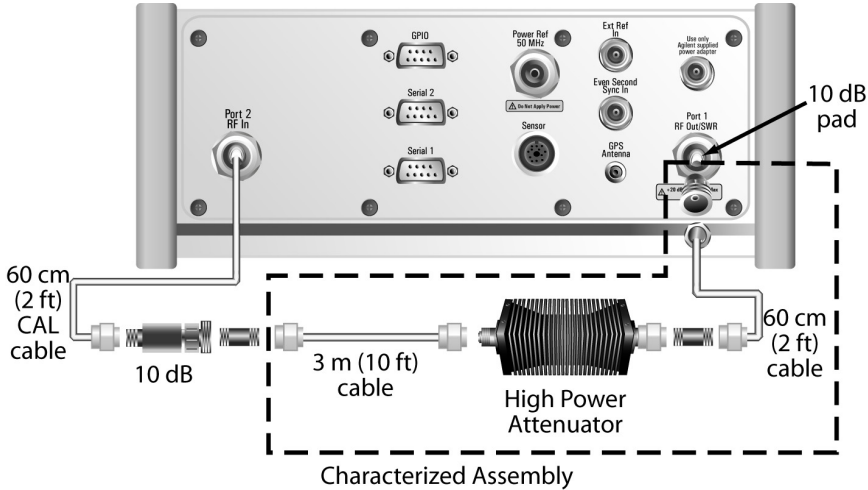
To Add a Marker to a Trace:

Step	Notes
1	[Marker]
2	[Marker]
3	[1], [2], [3], or [4]
4	[Type]
5	[Off], [Normal], or [Delta]
6	Locate the marker relative to the trace: [Marker to Peak], [Marker to Next Peak], [Marker to Min], or [Marker to Next Min]

Measuring Two Port Insertion Loss for Spectrum Analyzer, Channel Scanner, 1xEV-DO Analyzer, CDMA Analyzer, and Signal Generator (RF In Loss and RF Out Loss)

To prepare to perform spectrum analysis, Tx analysis (CDMA, W-CDMA, 1xEV-DO, and so forth), and signal generator measurements, you must store RF In Loss and RF Out Loss values.

Step	Notes
1	Connect the cable or device. Connect the 3 meter (10 ft) cable, high power attenuator, and other 60 cm (2 ft) cable (not used for normalization) between the two 10 dB pads that were used for normalization.



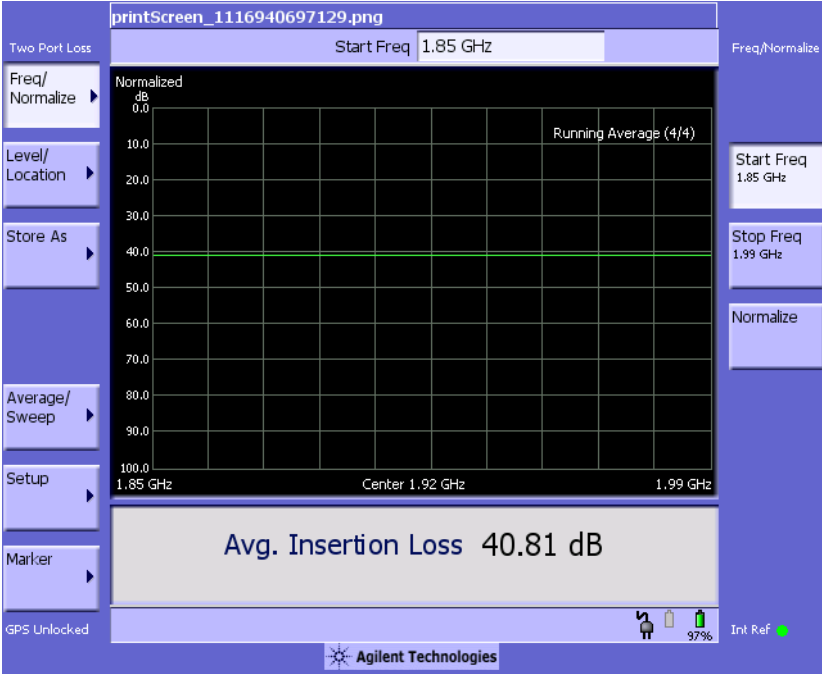
Two Port Insertion Loss

Two Port Insertion Loss

Measuring Two Port Insertion Loss

Step	Notes
2 [Level]	<p>If the insertion loss trace is not visible, you can change the reference level or use Autoscale to have the test set select a reference level for you.</p> <ul style="list-style-type: none">• Press [Autoscale] to display the trace so that it fills the screen from top to bottom.• Press [Ref Level] and then enter the appropriate value and press [dB] to manually select a level for the trace.• Press [Scale/Div] and then enter the appropriate value and press [dB] to manually select the number of dBs per line on the graticule.
3 [Store As]	
4 [Store As RF IN Loss]	Saves the RF In Loss value for use in later measurements.
5 [Store As RF OUT Loss]	Saves the RF Out Loss value for use in later measurements.

Figure 2-2 Two Port Insertion Loss Measurement Results, Including Effects of 60 cm (2 ft) Cable, 3 meter (10 ft) Cable, and High Power Attenuator.



Two Port Insertion Loss

Two Port Insertion Loss

Measuring Two Port Insertion Loss

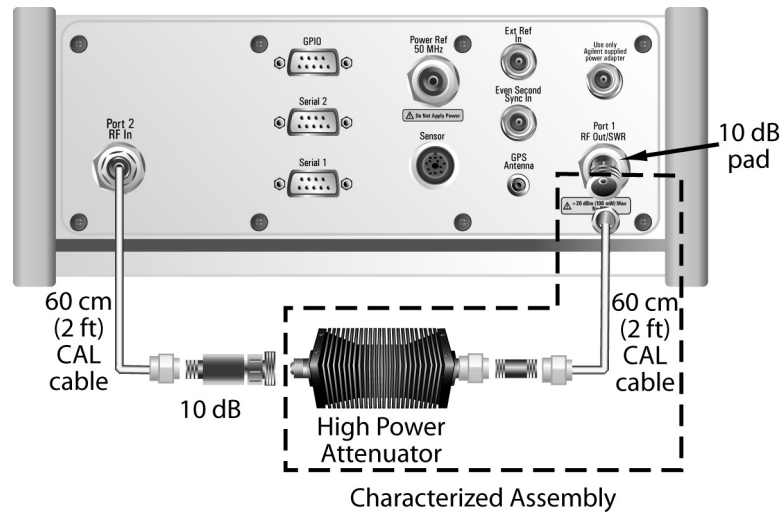
Measuring Insertion Loss for Power Meter (Option 600 Only)

NOTE

This measurement is only available if you have Option 600 (Power Meter), and requires an 8482A/8481A power sensor.

Before making a power measurement, you need to store a PM Loss value that will compensate for the loss of the devices you use to connect to the transmitter.

Step	Notes
1	Connect the cable or device.
	Connect the high power attenuator and remaining 60 cm (2 ft) cable (not the cable used for normalization) between the two 10 dB pads that were used for normalization.



Step	Notes
2 [Level/Location]	<p>If the insertion loss trace is not visible, you can change the reference level or use Autoscale to have the test set select a reference level for you.</p> <ul style="list-style-type: none"> • Press [Autoscale] to display the trace so that it fills the screen from top to bottom. • Press [Ref Level] and then enter the appropriate value and press [dB] to manually select a level for the trace. • Press [Scale/Div] and then enter the appropriate value and press [dB] to manually select the number of dBs per line on the graticule.
3 [Store As]	
4 [Store As PM Loss]	<p>Saves the loss for use with the power measurement. This PM Loss figure only remains valid for as long as you continue to use the same “characterized assembly”, that is, the same cables and pads.</p> <p>If Option 600 is not installed, [Store as PM Loss] and [PM Loss] are unavailable.</p>

Determining The Lowest (Worst) Insertion Loss and Its Frequency

Step	Notes
1 [Marker]	
2 On [Type] select Normal .	Each time you press this softkey, the selected option changes.
3 [Marker to Peak]	Places a marker on the highest peak. The marker value is displayed in the upper right.

Two Port Insertion Loss

Two Port Insertion Loss

Measuring Two Port Insertion Loss

Determining the Highest (Best) Insertion Loss and Its Frequency

Step	Notes
1 [Marker]	
2 On [Type] select Normal .	Each time you press this softkey, the selected option changes.
3 [Marker to Min]	Places a marker on the lowest peak. The marker value is displayed in the upper right.

Using the Delta Marker to Measure a Difference in Insertion Loss or Frequency

Step	Notes
1 [Marker]	
2 On [Type] select Normal .	Each time you press this softkey, the selected option changes.
3 [Marker to Peak]	
4 On [Type] select Delta .	Each time you press this softkey, the selected option changes.
5 [Marker to Min]	Two markers, for Normal and Delta, are displayed. The marker values are displayed in the upper right.

Activating Interference Rejection

Other signals sometimes interfere with insertion loss measurements when measuring the isolation between antennas. When measuring isolation between antennas in the presence of known or suspected interference, you can minimize the effect of the interference by activating Interference Rejection in the test set.

NOTE

Use of interference rejection will increase the measurement time. Interference rejection should be used if a known interfering signal exists or if the insertion loss

measurement displays suspicious characteristics such as a spike or rapid movements in the noise floor.

To Activate Interference Rejection:

Step	Notes
1 [Setup]	
2 On [Interference Rejection] select On .	Each time you press this softkey, the selected option changes.

Clearing Normalization

Clear Normalization deletes the current normalization data, enabling you to re-normalize the instrument for the same frequency range.

To Clear the Measurement Normalization Values:

Step	Notes
1 [Setup]	
2 [Clear Normalization]	

Setting Source Level

Source level enables you to set the output level of the internal source at the RF Out/SWR connector. You may enter a value from -100 dBm to +10 dBm.

To Set the Source Level:

Step	Notes
1 [Setup]	
2 On [Source Lev] select Manual .	Each time you press this softkey, the selected option changes.
3 Enter the start frequency of interest using the numeric keypad.	
4 [dB]	

Two Port Insertion Loss

Optimizing Dynamic Range

When using the default settings, the test set optimizes measurement accuracy at the expense of dynamic range. There may be times, however, when you prefer to gain dynamic range and lose some accuracy. For example, when measuring sector isolation on adjacent antennas, you may want to see a relatively large dynamic range, and your results will not be impaired significantly by 1 to 2 dB less accuracy. Optimizing for dynamic range gains you approximately 30 dB of dynamic range.

Step	Notes
1 [Setup]	
2 On [Optimize] select Range .	Each time you press this softkey, the selected option changes.

Setting the Pass/Fail Limits

The measurement limits setting enables you to alter the value of the maximum and minimum test limits for the Average Insertion Loss measurement. Limits are set in dB. These settings affect the metrics color display: red represents fail, green represents pass. Next to the displayed measurement value, a (P) indicating Pass, or (F) indicating Fail, will be shown to further indicate whether the value is within or outside the set limits.

To Set the Measurement Maximum and Minimum Limits:

Step	Notes
1 [Setup]	
2 [Limits]	
3 On [Limits] select On or Off .	<p>Enables you to toggle the measurement limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> • If set to On, Any measured value that exceeds the upper maximum or is less than the minimum limit will result in a failure indication for that value. • If set to Off, pass fail indicators seen in the metrics display portion of the display will not be displayed.
4 Set the upper limit. a. [Maximum Limit] b. Enter the number on the numeric keypad. c. [dB]	Maximum limit can be set from –100 dBm to +10 dBm.
5 Set the lower limit. a. [Minimum Limit] b. Enter the number on the numeric keypad. c. [dB]	Minimum limit can be set from –100 dBm to +10 dBm.

Two Port Insertion Loss
Measuring Two Port Insertion Loss

[“Measuring One Port Insertion Loss” on page 74](#)

[“Calibration - Minimizing your Workload” on page 74](#)

[“Performing \(and Calibrating\) a Basic One Port Insertion Loss measurement” on page 75](#)

[“Clearing Calibration” on page 78](#)

[“Displaying Location Information Using GPS” on page 78](#)

[“Setting Average, Sweep, and Restart” on page 79](#)

[“Adding a Marker” on page 83](#)

[“Setting One Port Insertion Loss Interference Rejection” on page 84](#)

[“Setting the Pass/Fail Limits” on page 85](#)

Measuring One Port Insertion Loss

The one port insertion loss measurement allows you to quantify signal loss in a cable or other device without connecting both ends of the cable or device to the test set. This measurement can be especially useful in measuring the loss of a feedline connected to the antenna on a tower.

This measurement, however, is less accurate than Two Port Insertion Loss. Therefore, when it's practical to connect both ends of a device to the test set—for example, when measuring your cables or a high power attenuator—it is better to use Two Port Insertion Loss.

NOTE

The test signal emitted from the SWR port is a sine wave, swept from the starting frequency to the stop frequency. When testing cables that are attached to antennas, test signals are radiated, and these test signals can cause interference. Verify that the signal used for the test cannot cause interference to another antenna.

Calibration - Minimizing your Workload

The **One Port Insertion Loss Calibration** is the same calibration as performed for two other measurements: **Return Loss** and **Distance to Fault**. If you have already calibrated for any of these three measurements, the calibration will apply to the other two measurements and “Calibrated” (together with the frequency range over which the calibration was performed) will be displayed on top left of the screen for all three.

If you have not previously performed a calibration, the word “Uncalibrated” appears at the top left of the measurement screen.

It is important that you keep the calibration frequency range as close as possible to the actual sweep frequencies you intend using for the measurement or measurements. Calibrating over a large GHz range when you only intend measuring over a smaller kHz range will induce inaccuracies into your results.

If you plan to perform a combination of **One-Port Insertion Loss**, **Return Loss** and **Distance to Fault** measurements, you can perform one calibration for all three measurements as long as you calibrate over a frequency range that incorporates all three of your measurements, and as long as your cables do not change. For this reason, if you are doing Distance to Fault measurements as well as any type of Insertion Loss measurement, Agilent recommends that you select your cable type before performing calibrations. Press [Mode], [Antenna/Cable], [Distance to Fault],

[Cable Type] to set the cable type.

The calibration remains valid until you do any one of the following:

- power off the test set
- change the start frequency to a new value that lies below the start frequency of your previous calibration
- change the stop frequency to a new value that lies above the stop frequency of your previous calibration
- change any of the jumper leads that you used for the calibration
- change any of the attenuators that you used for the calibration
- change the type of cable specified under the [Cable Type] menu key in the Distance to Fault measurement.

Performing (and Calibrating) a Basic One Port Insertion Loss measurement

Select the desired frequency range and calibrate the test set for a One Port Insertion Loss measurement. To calibrate your test set, you will need the following pieces of equipment:

- Cable, N (male) to N (male), part number 8120-8862 or 8121-1315
- Calibrated 50 ohm Open connector, part number 1250-3421
- Calibrated 50 ohm Short connector, part number 1250-3424
- Calibrated 50 ohm Load connector, part number 1250-3423

NOTE

All four of these required accessories are supplied as standard with your Agilent E7495A/B test set.

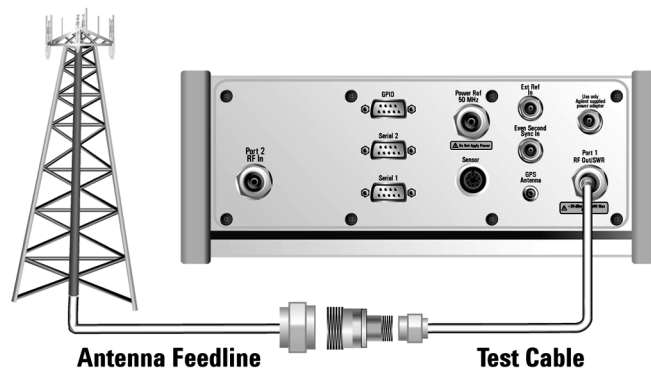
Step	Notes
1 Mode	
2 [Antenna/Cable]	
3 [One Port Insertion Loss]	The one port insertion loss measurement takes a few seconds to load.

One Port Insertion Loss

Measuring One Port Insertion Loss

Step	Notes
4	[Start Freq]
5	Enter the start frequency using the numeric keypad.
6	[Hz], [kHz], [MHz], or [GHz]
7	[Stop Freq]
8	Enter the stop frequency using the keypad.
9	[Hz], [kHz], [MHz], or [GHz]
10	<p>Check whether your analyzer has already been calibrated over the frequency range that you wish to measure. If it is already calibrated over the correct frequency range, you can omit the next step (Step 11) and go straight to Step 12.</p> <p>The analyzer displays its calibration status on the top left of the measurement screen. You only need to re calibrate if you:</p> <ul style="list-style-type: none">• power off the test set• change the start frequency to a new value that lies below the start frequency of your previous calibration• change the stop frequency to a new value that lies above the stop frequency of your previous calibration• change any of the jumper leads that you used for the calibration• change any of the attenuators that you used for the calibration• change the type of cable specified under the [Cable Type] menu key in the Distance to Fault measurement. <p>See “Calibration - Minimizing your Workload” on page 74 for more information.</p>

Step	Notes	
11	If your analyzer is uncalibrated, or has been calibrated over an unsuitable frequency, press [Calibrate]	Follow the instructions of the Calibration Wizard. The test set will calibrate over the desired frequency range.
12	Connect the antenna feedline and antenna.	Connect the antenna feedline cable to the RFout/SWR port.



13	Disconnect the feedline at the top of the tower, and connect a short connector to the feedline.	This step is necessary to get a good mismatch for the measurement.
----	---	--

One Port Insertion Loss

Measuring One Port Insertion Loss

Step	Notes
14 [Level]	<p>Below the trace on the screen is a table displaying the average insertion loss.</p> <p>If the trace is not visible, you can change the reference level or use Autoscale to have the test set select a reference level for you.</p> <ul style="list-style-type: none">• To choose Autoscale, press [Autoscale].• To set the level manually, press [Ref Level], enter a value using the numeric keypad, then press [dB].

Clearing Calibration

Clear Calibration deletes the current calibration data, enabling you to re-calibrate the instrument for the same frequency range.

To Clear the Measurement Calibration Data:

Step	Notes
1 [Setup]	
2 [Clear Calibration]	This will clear the calibration for all three one-port cable measurements.

Displaying Location Information Using GPS

If you are making a One Port Insertion Loss measurement, you can use GPS Location data to verify your location. For additional information on the GPS Data function, refer to [“Displaying GPS Location Data” on page 496](#)

To Display GPS Location Information:

Step	Notes
1 [Level/Location]	
2 On [GPS Location] select On .	<p>Displays GPS satellite location information. Uses the internal GPS to capture the location at which a measurement is made. The GPS information can be used to return to the same location. The Time Ref (Freq/Chan/Time Ref mode) button must be set to Internal GPS for this function to be active. Information logged includes longitude, latitude, altitude (feet/meters), and the number of satellites tracked.</p> <p>Each time you press this softkey, the selected option changes.</p>
3 Highlight [On]	Toggle to [On] to display GPS satellite location information. Toggle to [Off] to remove the location information

NOTE

If you prefer to have an electronic copy of the location information, see [“Saving Data” on page 503](#).

Setting Average, Sweep, and Restart

Setting the Sweep

You can select either continuous or single sweep. Continuous sweep provides repeated, ongoing measurements. Single sweep performs a single measurement that is repeated only when you push the Single button.

To set sweep:

Step	Notes
1 [Average/Sweep]	

One Port Insertion Loss

Measuring One Port Insertion Loss

Step	Notes
2 [Continuous] or [Single]	Each time you press this softkey, the selected option changes.

Setting Averaging

You can choose to have averaging On or Off and set the number of averages you want to take. Averaging only applies to the data, not to the trace. You can select from the following types of averaging:

- **Off:** Disables averaging.
- **Running:** Computes the new result as the weighted sum of the last result and the new measurement. The last result is weighted by $(n - 1)/n$. The new result is weighted by $1/n$. Each new measurement produces a new result.
- **Max Hold:** Is not an average, but on a point by point basis, displays the maximum amplitude for the given frequency or channel since Max Hold was turned on. It is updated when a new maximum occurs.
- **Group Average:** Makes the requested number of measurements, averages the measurement data, and displays the average as a single result trace. Measurement time will vary based on the requested number of averages and can take minutes for very large number of averages.
- **Group Max Average:** Makes the requested number of measurements before returning a single trace result. This trace is the maximum value seen at each trace point over the requested number of averages (measurements).

To set averaging:

Step	Notes
1	Set the number of averages. <ol style="list-style-type: none"> a. [Average] b. Enter the number of averages using the numeric keypad. c. [Enter]
2	Select the type of averaging you want to apply. <ol style="list-style-type: none"> a. [Average/Sweep] b. [Averaging] c. [Off], [Running Average], [Max Hold], [Group Average], or [Group Max Average]

NOTE

These two steps can be performed in any order. However, if you turn averaging on and a large number of averages has previously been set, there may be a delay before you can change the number of averages.

Setting Restart

When you have averaging turned **On** and you are in **Continuous** Sweep mode, you can restart the averaging by pressing the Restart menu key. The Restart key has no effect if you are in **Single** sweep mode.

To restart averaging:

Step	Notes
1	[Average/Sweep]

One Port Insertion Loss

Measuring One Port Insertion Loss

Step	Notes
2 [Restart]	This key is unavailable or has no effect when Sweep is set to Single . To restart a Single Sweep measurement, press [Single].

Adding a Marker

Markers can be used on traces to help you visually track up to four signals. Each marker has the following settings:

- **Type:** Provides three options, including:
 - **Off**
 - **Normal:** Places a diamond-shaped, colored marker, along with a number, 1-4, on the trace.
 - **Delta:** Associated with a normal marker. Therefore, a normal marker must exist prior to creating the delta marker. The delta marker displays the difference between the normal marker position and the delta marker position. Only one delta marker can be associated with a given normal marker. The normal marker must be active when Delta is selected.
- **Marker to Peak:** Places the active marker on the current greatest value of the trace.
- **Marker to Next Peak:** Places the active marker on the current second greatest value of the trace.
- **Marker to Min:** Places the active marker on the current lowest value of the trace.
- **Marker to Next Min:** Places the active marker on the current second lowest value of the trace.

To add a marker to a trace

Step	Notes
1	[Marker]
2	[Marker]
3	[1], [2], [3], or [4]
4	[Type]
5	[Off], [Normal], or [Delta]
6	Locate the marker relative to the trace: [Marker to Peak], [Marker to Next Peak], [Marker to Min], or [Marker to Next Min]

One Port Insertion Loss

Measuring One Port Insertion Loss

Setting One Port Insertion Loss Interference Rejection

Other signals can interfere with One Port Insertion Loss measurements. When making a one port insertion loss measurement in the presence of known or suspected interference, you can minimize the effect of the interference on the measurement by activating interference rejection in the test set.

NOTE

Use of interference rejection will increase the measurement time. Interference rejection should be used if a known interfering signal exists or if the one port insertion loss measurement displays suspicious characteristics such as a spike or rapid movements in the noise floor.

To activate interference rejection:

Step	Notes
1 [Setup]	
2 On [Interference Rejection] select On .	Each time you press this softkey, the selected option changes.

Setting the Pass/Fail Limits

The measurement limits setting enables you to alter the value of the maximum and minimum test limits for the Average Insertion Loss measurement. Limits are set in dB. These settings affect the metrics color display: red represents fail, green represents pass. Next to the displayed measurement value, a (P) indicating Pass, or (F) indicating Fail, will be shown to further indicate whether the value is within or outside the set limits.

To Set the Measurement Maximum and Minimum Limits:

Step	Notes
1 [Setup]	
2 [Limits]	
3 On [Limits] select On or Off .	<p>Enables you to toggle the measurement limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> • If set to On, Any measured value that exceeds the upper maximum or is less than the minimum limit will result in a failure indication for that value. • If set to Off, pass fail indicators seen in the metrics display portion of the display will not be displayed.
4 Set the upper limit.	Maximum limit can be set from –100 to 100 dBm.
a. [Maximum Limit]	
b. Enter the number on the numeric keypad.	
c. [dB]	
5 Set the lower limit.	Maximum limit can be set from –100 to 100 dBm.
a. [Minimum Limit]	
b. Enter the number on the numeric keypad.	
c. [dB]	

One Port Insertion Loss
Measuring One Port Insertion Loss

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- “Performing (and Calibrating) a Basic Return Loss Measurement” on page 89
- “Clearing Calibration” on page 92
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- “Setting Return Loss Interference Rejection” on page 92
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Return Loss

Measuring Return Loss

Measuring Return Loss

Return loss is a measure of reflection characteristics. One way you can use the return loss measurement is to detect problems in the antenna feedline system and the antenna itself. A portion of the incident power will be reflected back to the source from each transmission line fault as well as the antenna. The ratio of the reflected voltages to the incident voltage is called the reflection coefficient. The reflection coefficient is a complex number, meaning it has both magnitude and phase information. In S-parameter terms, Return Loss is referred to as an S_{11} measurement.

NOTE

Test signals can cause interference. When testing cables attached to antennas, test signals are radiated. Verify that the signal used for the test cannot cause interference to another antenna.

Calibration - Minimizing your Workload

The **Return Loss Calibration** is the same calibration as performed for two other measurements: **One-Port Insertion Loss** and **Distance to Fault**. If you have already calibrated for any of these three measurements, the calibration will apply to the other two measurements and “Calibrated” (together with the frequency range over which the calibration was performed) will be displayed on top left of the screen for all three.

If you have not previously performed a calibration, the word “Uncalibrated” appears at the top left of the measurement screen.

It is important that you keep the calibration frequency range as close as possible to the actual sweep frequencies you intend using for the measurement or measurements. Calibrating over a large GHz range when you only intend measuring over a smaller kHz range will induce inaccuracies into your results.

If you plan to perform a combination of **One-Port Insertion Loss**, **Return Loss** and **Distance to Fault** measurements, you can perform one calibration for all three measurements as long as you calibrate over a frequency range that incorporates all three of your measurements, and as long as your cables do not change. For this reason, if you are doing Distance to Fault measurements as well as any type of Insertion Loss measurement, Agilent recommends that you select your cable type before performing calibrations. Press [Mode], [Antenna/Cable], [Distance to Fault], [Cable Type] to set the cable type.

The calibration remains valid until you do any one of the following:

- power off the test set
- change the start frequency to a new value that lies below the start frequency of your previous calibration
- change the stop frequency to a new value that lies above the stop frequency of your previous calibration
- change any of the jumper leads that you used for the calibration
- change any of the attenuators that you used for the calibration
- change the type of cable specified under the [Cable Type] menu key in the Distance to Fault measurement.

Performing (and Calibrating) a Basic Return Loss Measurement

Select the desired frequency range and calibrate the test set (using calibrated Open, Short, and Load connectors) for a return loss measurement.

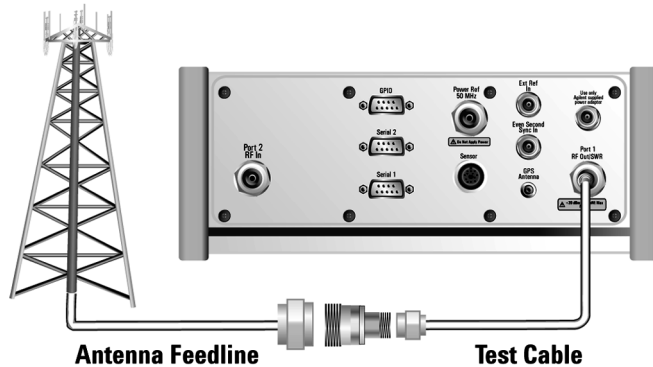
Step	Notes
1 Mode	
2 [Antenna/Cable]	
3 [Return Loss]	The return loss measurement takes a few seconds to load.
4 [Start Freq]	
5 Enter the start frequency using the numeric keypad.	
6 [Hz], [kHz], [MHz], or [GHz]	
7 [Stop Freq]	
8 Enter the stop frequency using the keypad.	The stop frequency should be larger than the start frequency.

Return Loss

Measuring Return Loss

Step	Notes
9	[Hz], [kHz], [MHz], or [GHz]
10	<p>Check whether your analyzer has already been calibrated over the frequency range that you wish to measure. If it is already calibrated over the correct frequency range, you can omit the next step (Step 11) and go straight to Step 12.</p> <p>The analyzer displays its calibration status on the top left of the measurement screen. You only need to re calibrate if you:</p> <ul style="list-style-type: none"> • power off the test set • change the start frequency to a new value that lies below the start frequency of your previous calibration • change the stop frequency to a new value that lies above the stop frequency of your previous calibration • change any of the jumper leads that you used for the calibration • change any of the attenuators that you used for the calibration • change the type of cable specified under the [Cable Type] menu key in the Distance to Fault measurement. <p>See “Calibration - Minimizing your Workload” on page 88 for more information.</p>
11	<p>If your analyzer is uncalibrated, or has been calibrated over an unsuitable frequency, press [Calibrate]</p> <p>Follow the instructions of the Calibration Wizard. The test set will calibrate over the desired frequency range.</p>
12	<p>Connect the antenna feedline and antenna.</p> <p>Connect the antenna feedline cable to the RFout/SWR port.</p>

Step	Notes
------	-------



13 [Level]

Below the Return Loss display is a table displaying the frequency Return Loss, and Standing Wave Ratio (SWR) of the best and worst return losses. These values may be changing rapidly. To isolate a signal, use a single sweep, or apply averaging to the trace data.

If the Return Loss trace is not visible, you can change the reference level, or use Autoscale to have the test set select a reference level for you.

- To choose Autoscale, press [Autoscale].
- To set the level manually, press [Ref Level], enter a value using the numeric keypad, then press [dB].

NOTE

If the Return Loss measurement looks suspect (less than 5 dB), you may want to perform a Distance to Fault measurement to determine if a noticeable fault exists and where it may be located. For more information see [“Distance to Fault” on page 99](#).

Return Loss

Measuring Return Loss

Clearing Calibration

Clear Calibration deletes the current calibration data, enabling you to re-calibrate the instrument for the same frequency range.

To Clear the Measurement Calibration Data:

Step	Notes
1	[Setup]
2	[Clear Calibration]

Isolating a Return Loss Signal Using a Single Sweep

Step	Notes
1	[Average/Sweep]
2	[Single] Activate the single sweep. Press [Continuous] if you want to start multiple sweeps.

Setting Return Loss Interference Rejection

Other signals can interfere with return loss measurements. When making a return loss measurement in the presence of known or suspected interference, you can minimize the effect of the interference on the measurement by activating interference rejection in the test set.

NOTE

Use of interference rejection will increase the measurement time. Interference rejection should be used if a known interfering signal exists or if the Return Loss measurement displays suspicious characteristics such as a spike or rapid movements in the noise floor.

Step	Notes
1	[Setup]

Step	Notes
2 On [Interference Rejection] select On .	Each time you press this softkey, the selected option changes.

Return Loss

Measuring Return Loss

Setting Average, Sweep, and Restart

Setting the Sweep

You can select either continuous or single sweep. Continuous sweep provides repeated, ongoing measurements. Single sweep performs a single measurement that is repeated only when you push the Single button.

To set sweep:

Step	Notes
1 [Average/Sweep]	
2 [Continuous] or [Single]	Each time you press this softkey, the selected option changes.

Setting Averaging

You can choose to have averaging on or off and set the number of averages you want to take. Averaging only applies to the data, not the trace. You can select from the following types of averaging:

- **Off:** Disables averaging.
- **Running:** Computes the new result as the weighted sum of the last result and the new measurement. The last result is weighted by $(n - 1)/n$. The new result is weighted by $1/n$. Each new measurement produces a new result.
- **Max Hold:** Is not an average, but on a point by point basis, displays the maximum amplitude for the given frequency or channel since Max Hold was turned on. It is updated when a new maximum occurs.
- **Group Average:** Makes the requested number of measurements, averages the measurement data, and displays the average as a single result trace. Measurement time will vary based on the requested number of averages and can take minutes for very large number of averages.
- **Group Max Average:** Makes the requested number of measurements before returning a single trace result. This trace is the maximum value seen at each trace point over the requested number of averages (measurements).

To set averaging:

Step	Notes
1	Set the number of averages. <ol style="list-style-type: none"> [Average] Enter the number of averages using the numeric keypad. [Enter]
2	Select the type of averaging you want to apply. <ol style="list-style-type: none"> [Average/Sweep] [Averaging] [Off], [Running Average], [Max Hold], [Group Average], or [Group Max Average]

NOTE

These two steps can be performed in any order. However, if you turn averaging on and a large number of averages has previously been set, there may be a delay before you can change number of averages.

Setting Restart

When you have averaging turned **On** and you are in **Continuous** Sweep mode, you can restart the averaging by pressing the Restart menu key. The Restart key has no effect if you are in **Single** sweep mode.

To restart averaging:

Step	Notes
1	[Average/Sweep]
2	[Restart] <p>This key is unavailable or has no effect when Sweep is set to Single. To restart a Single Sweep measurement, press [Single].</p>

Return Loss

Measuring Return Loss

Adding a Marker

Markers can be used on traces to help you visually track up to four signals. Each marker has the following settings:

- **Type:** Provides three options, including:
 - **Off**
 - **Normal**, which places a diamond-shaped, colored marker, along with a number, 1-4, on the trace.
 - **Delta**, is associated with a normal marker. Therefore, a normal marker must exist prior to creating the delta marker. The delta marker displays the difference between the normal marker position and the delta marker position. Only one delta marker can be associated with a given normal marker. The normal marker must be active when Delta is selected.
- **Marker to Peak:** Places the active marker on the current greatest value of the trace.
- **Marker to Next Peak:** Places the active marker on the current second greatest value of the trace.
- **Center Freq to Marker:** Scrolls to locate the current marker in the center of the trace.
- **Ref Level to Marker:** Scrolls the trace to place the marker at the top of the screen. To reset the reference level, choose [Level/Location] [Autoscale].

To Add a Marker to a Trace:

Step	Notes
1	[Marker]
2	[Marker]
3	[1], [2], [3], or [4]
4	[Type]
5	[Off], [Normal], or [Delta]
6	Locate the marker relative to the trace: <ul style="list-style-type: none"> • [Marker to Peak] • [Marker to Next Peak]

Step	Notes
7	Locate the trace relative to the marker: <ul style="list-style-type: none"> • [Center Freq to Marker] • [Ref Level to Marker]

Displaying Location Information Using GPS

If you are making a Return Loss measurement, you may use GPS Location data to verify your location. For additional information on the GPS Data function, refer to “[Displaying GPS Location Data](#)” on page 496

To Display GPS Location Information:

Step	Notes
1	[Level/Location]
2	On [GPS Location] select On . Displays GPS satellite location information. Uses the internal GPS to capture the location of a measurement. The GPS information can be used to return to the same location. The Time Ref (Freq/Chan/Time Ref mode) button must be set to Internal GPS for this function to be active. Information logged includes longitude, latitude, altitude (feet/meters), and the number of satellites tracked. Each time you press this softkey, the selected option changes.
3	Highlight [On] Toggle to [On] to display GPS satellite location information. Toggle to [Off] to remove the location information

NOTE If you prefer to have an electronic copy of the location information, see “[Saving Data](#)” on page 503.

Return Loss

Measuring Return Loss

Setting the Pass/Fail Limits

The measurement limits setting enables you to alter the value of the upper limit. Limits are set in dB and are relative. The setting you choose defines the location of the limit line displayed on the screen. The setting affect the metrics color display: red represents fail, green represents pass.

To Set the Measurement Limit:

Step	Notes
1	[Setup]
2	[Limits]
3	<p>On [Limits] select On or Off.</p> <p>Enables you to toggle the measurement limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> • If set to On, a limit line is displayed on the screen. Any measured value that does not exceed the limit will result in a failure indication for that value. • If set to Off, neither a limit indicator is displayed nor is a pass fail indicator seen in the metrics display portion of the display.
4	<p>Set the limit.</p> <p>Maximum limit: Ref Level (top of display)</p> <p>Minimum limit: bottom of display</p> <p>a. [RTN Loss Limit]</p> <p>b. Enter the number on the numeric keypad.</p> <p>c. [dB]</p>

- “Measuring Distance to Fault” on page 100
- “Measured Distance - the Effects of Frequency and Points” on page 100
- “Resolution - the Effects of Frequency and Points” on page 101
- “Automatic and Manual Distance to Fault Measurements” on page 101
- “Performing a Basic Distance to Fault Measurement (Manual Frequency Range)” on page 104
- “Performing a Basic Distance to Fault Measurement (Automatic Frequency Range)” on page 107
- “Clearing Calibration” on page 110
- “Displaying Location Information Using GPS” on page 110
- “Viewing a Single Distance to Fault Sweep” on page 111
- “Displaying the Top Four Faults” on page 112
- “Setting Interference Rejection for a Distance to Fault Measurement” on page 112
- “Setting Average, Sweep, and Restart” on page 113
- “Adding a Marker” on page 115
- “Setting the Pass/Fail Limits” on page 116

Measuring Distance to Fault

A signal is transmitted from the RF Out/SWR port of the test set to the cable-under-test. The signals reflected from faults in the cable are received by the test set.

In performing this measurement, the test set uses frequency domain reflectometry. The changing interference of the transmitted and reflected signals contains information about the distance to one or more faults. This information can be used to find the physical distance to the faults. The distance displayed on the test set is the physical distance to the probable faults, corrected for the cable loss and velocity propagation factor of the cable.

Measured Distance - the Effects of Frequency and Points

It is not always obvious how frequency range affects measured distance and resolution, and it often appears to be counter-intuitive. If you are new to making Distance to Fault measurements, this section will help clarify what is happening.

In the following equations

- The Speed of Light is represented by the letter 'c'. This is a constant value of 3×10^8 metres per second.
- Your test cable's transmission speed (relative to light) is V_{Rel}

The **Measured Distance** (in meters) of the DTF measurement is determined by the following equation:

$$\text{Measured Distance (in meters)} = \frac{\frac{1}{4} \times \text{Number of Points} \times c \times V_{Rel}}{\text{Frequency Span}}$$

You can see from this equation that:

- To **increase** the measured distance:
 - you can **increase** the **number of points**, or
 - you can **reduce** the **frequency span**.
- To **reduce** the measured distance:, you can
 - you can **reduce** the **number of points**, or
 - you can **increase** the **frequency span**.

Resolution - the Effects of Frequency and Points

It is not always obvious how frequency range affects measured distance and resolution, and it often appears to be counter-intuitive. If you are new to making Distance to Fault measurements, this section will help clarify what is happening.

The **Resolution Distance** (in meters) of the DTF measurement, that is, the shortest distance between two faults that can still be resolved by the analyzer, is determined by the following equation:

$$\text{Resolution Distance (in meters)} = \frac{\text{Measured Distance (in meters)}}{\frac{1}{2} \times \text{Number of Points}}$$

NOTE

Please be careful how you interpret this equation. Note that to *increase* the *resolution*, you need to *reduce* the *Resolution Distance*; to *reduce* the *resolution*, you need to *increase* the *Resolution Distance*.

You can see from this equation that:

- To **increase** the resolution, that is, to *reduce* the *Resolution Distance*:
 - you can **increase** the **number of points**, or
 - you can **reduce** the **measured distance**.
- To **reduce** the resolution, that is, to *increase* the *Resolution Distance*, you can
 - you can **reduce** the **number of points**, or
 - you can **increase** the measured distance.

NOTE

Although you can set your number of points to 256, 512, or 1024, you will only ever be able to save 256 data points when you save trace data. This is because only 256 points are ever used to display the trace, regardless of how many points you have used to actually make the measurement. You will not, however, be losing any resolution, or reducing the quality of your data. The results will still reflect the true number of data points that you specified.

Automatic and Manual Distance to Fault Measurements

The test set provides two ways of measuring distance to fault:

- **Automatic Frequency Range.** You select the measurement distance and the test set automatically selects the **Start Frequency** and the **Stop Frequency**. This

Distance to Fault

Measuring Distance to Fault

measurement distance is set using the [Distance] menu key on the [Freq/Dist/Calibrate] menu. In this mode, the displayed and measured differences are the same. There are 256 measurement points across the distance you set. This approach provides the maximum measurement resolution across the selected distance. The disadvantage is that the start and stop frequencies are automatically set and may limit the test set's ability to sweep through filters or lighting protectors. This mode is best used for checking a cable that has no frequency limiting devices.

Example 1: If you set [Start Distance] to 0 m (0 ft), and the [Stop Distance] to 60 m (197 ft), and you specify 256 Data Points, the instrument automatically selects a [Start Freq] of 375 MHz and a [Stop Freq] of 659.8 MHz.

Example 2: If you again set [Start Distance] to 0 m (0 ft), and the [Stop Distance] to 60 m (197 ft), and but this time you specify 1024 Data Points to give you greater resolution, the instrument automatically selects a [Start Freq] of 375 MHz and a [Stop Freq] of 1.5142 GHz.

- **Manual Frequency Range.** When set to **Manual**, you must specify the **Start Frequency** and the **Stop Frequency**, and the measured distance is worked out from these frequencies. Generally, the typical start and stop frequencies you use will result in a measured distance that will be larger than the distance over which you want to look for faults.

NOTE

The **Measured Distance** and the **Displayed Distance** can be different. The distance over which the instrument has made its measurements, and which has been derived from the frequencies you specified, is called the **Measured Distance**. This is displayed at the top right corner of the measurement screen.

The **Displayed Distance** refers to that part of the entire **Measured Distance** that you choose to display on your measurement screen. You set the **Displayed Distance** manually by pressing the [Start Distance] and the [Stop Distance] menu keys on the [Freq/Dist/Calibrate] menu.

To help isolate faults over the length of interest, you can set a displayed distance less than the measured distance. The displayed distance is set using the [Start Distance] and the [Stop Distance] menu keys on the [Freq/Dist/Calibrate] menu.

Keep in mind that there are 256, 512, or 1024 measurement points across the measured distance. The exact number of measurement points is set using the [Data Points] key on the [Setup] menu. Therefore, the measurement points across the chosen displayed distance will be a ratio of displayed distance to measured distance times the number of points you have specified. The higher the number of data points, the greater the measurement resolution.

In most cases, the default resolution using 256 data points will be adequate to locate the faults, but if more resolution is needed you can increase the span between the start and stop frequencies (which will decrease the measured distance) or use the other approach, automatic frequency range. If the measurement distance is not long enough for the cable you are testing, reduce the span between the start and stop frequencies (which will increase the measurement distance) or use automatic frequency range.

NOTE

When testing cables attached to antennas, test signals are radiated from the test antenna. Verify that the signal used for the test, and therefore being radiated from the test antenna, cannot interfere with other radiated signals from other antennas.

Calibration - Minimizing your Workload

The **Distance to Fault** calibration is the same calibration as performed for the **Return Loss** and **One-Port Insertion Loss** measurements. If you have already calibrated for any of these three measurements, the calibration will apply to the other two measurements and “Calibrated” (together with the frequency range over which the calibration was performed) will be displayed on top left of the screen for all three.

If you have not previously performed a calibration, the word “Uncalibrated” appears at the top left of the measurement screen.

It is important that you keep the calibration frequency range as close as possible to the actual sweep frequencies you intend using for the measurement or measurements. Calibrating over a large GHz range when you only intend measuring over a smaller kHz range will induce inaccuracies into your results.

If you plan to perform a combination of **One-Port Insertion Loss**, **Return Loss** and **Distance to Fault** measurements, you can perform one calibration for all three measurements as long as you calibrate over a frequency range that incorporates all three of your measurements, and as long as your cables do not change. For this reason, if you are doing Distance to Fault measurements as well as any type of Insertion Loss measurement, Agilent recommends that you select your cable type before performing calibrations. Press [Mode], [Antenna/Cable], [Distance to Fault], [Cable Type] to set the cable type.

The calibration remains valid until you do any one of the following:

- power off the test set
- change the start frequency to a new value that lies below the start frequency of your previous calibration

Distance to Fault

Measuring Distance to Fault

- change the stop frequency to a new value that lies above the stop frequency of your previous calibration
- change any of the jumper leads that you used for the calibration
- change any of the attenuators that you used for the calibration
- change the type of cable specified under the [Cable Type] menu key.

Performing a Basic Distance to Fault Measurement (Manual Frequency Range)

Step	Notes
1	Mode
2	[Antenna/Cable]
3	[Distance to Fault] The distance to fault measurement takes a few seconds to load.
4	On [Freq Range] select Manual . Each time you press this softkey, the selected option changes.
5	[Start Freq]
6	Enter the start frequency using the numeric keypad.
7	[Hz], [kHz], [MHz], or [GHz]
8	[Stop Freq]
9	Enter the stop frequency using the numeric keypad.
10	[Hz], [kHz], [MHz], or [GHz]
11	On [Units] select Meters or Feet . Each time you press this softkey, the selected option changes.
12	[Start Distance]

Step	Notes
13	<p>Enter the start distance using the numeric keypad.</p> <p>The start distance you can enter cannot be greater than the distance displayed in the Measured Distance window at the top right. If you need a larger distance, reduce the start and stop frequency span.</p> <p>If your Start Distance is 0 m (0 ft), you will see a peak corresponding to 0 m (0 ft). This is caused by reflection from the junction between your analyzer and the cable under test. This does not necessarily indicate a problem, but be sure that this connection is tight and clean.</p>
14	<p>[Stop Distance]</p>
15	<p>Enter the stop distance using the numeric keypad.</p> <p>The stop distance you can enter cannot be greater than the distance displayed in the Measured Distance window at the top right, but must be greater than the start distance previously entered. If you need a larger distance, reduce the start and stop frequency span.</p>
16	<p>[Cable Type]</p>
17	<p>On [Cable Type] on the right, select RG, BTS, or Cust.</p> <p>Each time you press this softkey, the selected option changes. If you select RG or BTS, you will be asked to select from a list of common cable types, the specific type of cable you are measuring [Select Cable].</p> <p>If the type of cable you are measuring is not listed, you need to select Cust (Custom Cable).</p>
18	<p>[Select Cable], or [Cable Atten] and then [Prop Vel]</p>

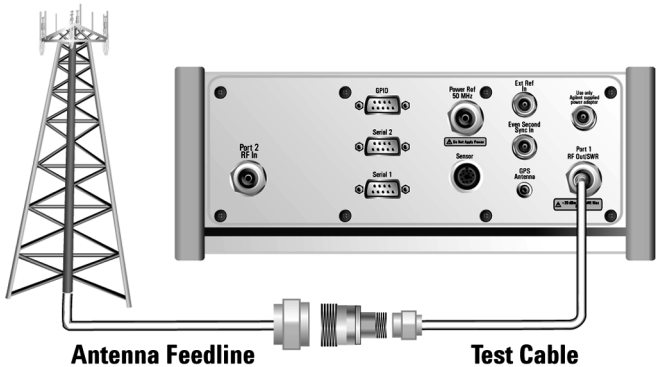
Distance to Fault

Distance to Fault

Measuring Distance to Fault

Step	Notes
19	<p>Select the cable using the up and down arrow buttons, or specify the characteristics of your custom cable.</p> <p>If the type of cable you are measuring is not listed, you need to select Cust (Custom Cable), and then specify its attenuation [Cable Atten.] in dB per 100 m (or in dB per 100 ft.) You will also need to specify the speed at which signals travel along this cable [Prop Vel], measured as a percentage of the speed of light in a vacuum.</p> <p>Most cable manufactures provide a table showing attenuation versus frequency for each type of cable. Remember that attenuation varies with frequency, so select an attenuation value that corresponds as closely as possible to the center of the frequency range you are using.</p>
20	[Select]
21	<p>Check whether your analyzer has already been calibrated over the frequency range and with the correct cable type that you wish to measure. If it is already calibrated over the correct frequency range and cable type, you can omit the next steps (Step 22 and Step 23) and go straight to Step 24.</p> <p>The analyzer displays its calibration status on the top left of the measurement screen. You only need to re calibrate if you:</p> <ul style="list-style-type: none">• power off the test set• change the start frequency to a new value that lies below the start frequency of your previous calibration• change the stop frequency to a new value that lies above the stop frequency of your previous calibration• change any of the jumper leads that you used for the calibration• change any of the attenuators that you used for the calibration• change the type of cable specified under the [Cable Type] menu key. <p>See “Calibration - Minimizing your Workload” on page 103 for more information.</p>

Step	Notes
22	If your analyzer is uncalibrated, or has been calibrated over an unsuitable frequency or with the incorrect cable type, press [Freq/Dist/Calibrate]
23	[Calibrate] Follow the Calibration Wizard.
24	Connect the antenna feedline and antenna. Connect the antenna feedline to the RF Out/SWR port.



25	(Recommended) [Level] [Autoscale] If you prefer to set the level manually, after pressing [Level], press [Ref Level]. Then enter the value you want using the numeric keypad and press [dB].
----	--

Performing a Basic Distance to Fault Measurement (Automatic Frequency Range)

Step	Notes
1	Mode

Distance to Fault

Measuring Distance to Fault

Step	Notes
2	[Antenna/Cable]
3	[Distance to Fault] The distance to fault measurement takes a few seconds to load.
4	On [Freq Range] select Auto . Each time you press this softkey, the selected option changes.
5	On [Units] select Meters or Feet . Each time you press this softkey, the selected option changes.
6	[Start Distance] For greater ease of use, you do not need to display the measurement results for the entire cable length that you are measuring. If you want to zoom in on a small section of the cable, enter here the distance from the start of the cable. If you want to look at the whole cable, leave this at the default setting of 0 m (0 ft). If your Start Distance is 0 m (0 ft), you will see a peak corresponding to 0 m (0 ft). This is caused by reflection from the junction between your analyzer and the cable under test. This does not necessarily indicate a problem, but be sure that this connection is tight and clean.
7	Using the numeric keypad, enter the start distance for the part of the cable that you wish to zoom in on.
8	[Stop Distance]
9	Using the numeric keypad, enter the stop distance for the part of the cable that you wish to zoom in on. The greatest accuracy is obtained when you enter a cable length slightly greater than the cable length being tested. If you are not sure of the cable length, enter a value 1.25 times the estimated length, and enter a start distance value of 0 m (0 ft) as described in Step 6. Depending on the return loss of the antenna or device at the end of the cable, you may see a high relative mismatch displayed at the actual length of the cable

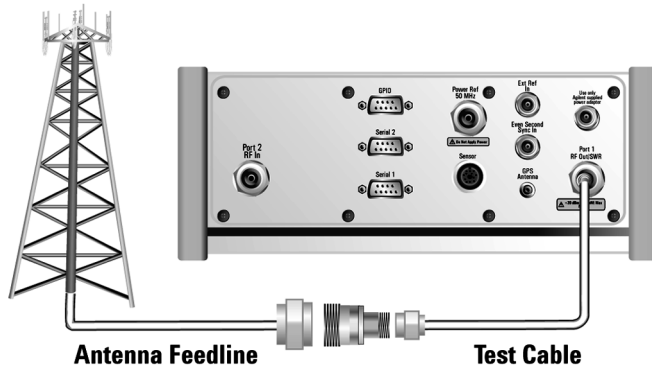
Step	Notes
10 [Cable Type]	
11 On [Cable Type] on the right, select RG , BTS , or Cust .	<p>Each time you press this softkey, the selected option changes. If you select RG or BTS, you will be asked to select from a list of common cable types, the specific type of cable you are measuring [Select Cable].</p> <p>If the type of cable you are measuring is not listed, you need to select Cust (Custom Cable).</p>
12 [Select Cable], or [Cable Atten] and then [Prop Vel]	
13 Select the cable using the up and down arrow buttons, or specify the characteristics of your custom cable.	<p>If the type of cable you are measuring is not listed, you need to select Cust (Custom Cable), and then specify its attenuation [Cable Atten.] in dB per 100 m (or in dB per 100 ft.) You will also need to specify the speed at which signals travel along this cable [Prop Vel], measured as a percentage of the speed of light in a vacuum.</p> <p>Most cable manufactures provide a table showing attenuation versus frequency for each type of cable. Remember that attenuation varies with frequency, so select an attenuation value that corresponds as closely as possible to the center of the frequency range you are using.</p>
14 [Select]	
15 [Freq/Dist/ Calibrate]	
16 [Calibrate]	Follow the Calibration Wizard.
17 Connect the antenna feedline and antenna.	Connect the antenna feedline to the RF Out/SWR port.

Distance to Fault

Distance to Fault

Measuring Distance to Fault

Step	Notes
------	-------



18 (Recommended) [Level] [Autoscale]	If you prefer to set the level manually, after pressing [Level], press [Ref Level]. Then enter the value you want using the numeric keypad and press [dB].
---	--

Clearing Calibration

Clear Calibration deletes the current calibration data, enabling you to re-calibrate the instrument for the same frequency range.

To Clear the Measurement Calibration Data:

Step	Notes
1 [Setup]	
2 [Clear Calibration]	

Displaying Location Information Using GPS

If you are making a Distance to Fault measurement, you may use GPS Location data to verify your location. For additional information on the GPS Data function, refer to “Displaying GPS Location Data” on page 496

To Display GPS Location Information:

Step	Notes
1 [Level/Location]	
2 On [GPS Location] select On .	Displays GPS satellite location information. Uses the internal GPS to capture the location of a measurement. The GPS information can be used to return to the same location. The Time Ref (Freq/Chan/Time Ref mode) button must be set to Internal GPS for this function to be active. Information logged includes longitude, latitude, altitude (feet/meters), and the number of satellites tracked. Each time you press this softkey, the selected option changes.
3 Highlight [On]	Toggle to [On] to display GPS satellite location information. Toggle to [Off] to remove the location information

Distance to Fault

NOTE

If you prefer to have an electronic copy of the location information, see [“Saving Data” on page 503](#).

Viewing a Single Distance to Fault Sweep

Step	Notes
1 [Average/Sweep]	
2 [Single]	Activates the single sweep. Press [Continuous] if you want to start multiple sweeps.

NOTE

Every time you wish to perform another single sweep, you need to press the [Single]

Distance to Fault

Measuring Distance to Fault

key. Pressing the [Restart] key does not start another single sweep—[Restart] only restarts the averaging.

Displaying the Top Four Faults

When measuring distance to fault, you can display the top four faults with markers on the trace. Even if the Fault Indicators are not set to **On**, the position and the severity of the top four cable faults are still listed in the Metrics Display section at the bottom of the screen.

If your Start Distance is 0 m (0 ft), you will see a peak corresponding to 0 m (0 ft). This is caused by reflection from the junction between your analyzer and the cable under test. This does not necessarily indicate a problem, but be sure that this connection is tight and clean.

Step	Notes
1 [Setup]	
2 On [Fault Indicators] select On .	Each time you press this softkey, the selected option changes. When set to On , the positions of the top four faults are indicated on the trace with four numbered yellow triangles. If you have Pass/Fail Limits set to On (Setting the Pass/Fail Limits , on page 116), the yellow triangles will be colored red for any faults that exceed your pre-defined limit.

Setting Interference Rejection for a Distance to Fault Measurement

Other signals can interfere with distance to fault measurements. When making a distance to fault measurement in the presence of known or suspected interference, you can minimize the effect of the interference on the measurement by activating interference rejection in the test set.

NOTE

Use of interference rejection will increase the measurement time. Interference rejection should be used if a known interfering signal exists or if the distance to fault measurement displays suspicious characteristics such as a spike or rapid movements in the noise floor.

To Activate Interference Rejection:

Step	Notes
1 [Setup]	
2 On [Interference Rejection] select On .	Each time you press this softkey, the selected option changes.

Setting Average, Sweep, and Restart

Setting the Sweep

You can select either continuous or single sweep. Continuous sweep provides repeated, ongoing measurements. Single sweep performs a single measurement that is repeated only when you push the Single button.

To set sweep:

Step	Notes
1 [Average/Sweep]	
2 [Continuous] or [Single]	Each time you press this softkey, the selected option changes.

Setting Averaging

You can choose to have averaging **On** or **Off** and set the number of averages you want to take. Averaging only applies to the data, not the trace. You can select from the following types of averaging:

- **Off:** Disables averaging.
- **Running:** Computes the new result as the weighted sum of the last result and the new measurement. The last result is weighted by $(n - 1)/n$. The new result is weighted by $1/n$. Each new measurement produces a new result.
- **Max Hold:** Is not an average, but on a point by point basis, displays the maximum amplitude for the given frequency or channel since Max Hold was turned on. It is updated when a new maximum occurs.
- **Group Average:** Makes the requested number of measurements, averages the

Distance to Fault

Measuring Distance to Fault

measurement data, and displays the average as a single result trace. Measurement time will vary based on the requested number of averages and can take minutes for very large number of averages.

- **Group Max Average:** Makes the requested number of measurements before returning a single trace result. This trace is the maximum value seen at each trace point over the requested number of averages (measurements).

To set averaging:

Step	Notes
1	Set the number of averages. <ol style="list-style-type: none">[Average]Enter the number of averages using the numeric keypad.[Enter]
2	Select the type of averaging you want to apply. <ol style="list-style-type: none">[Average/Sweep][Averaging][Off], [Running Average], [Max Hold], [Group Average], or [Group Max Average]

NOTE

These two steps can be performed in any order. However, if you turn averaging on and a large number of averages has previously been set, there may be a delay before you can change number of averages.

Setting Restart

When you have averaging turned **On** and you are in **Continuous** Sweep mode, you can restart the averaging by pressing the Restart menu key. The Restart key has no effect if you are in **Single** sweep mode.

To restart averaging:

Step	Notes
1 [Average/Sweep]	
2 [Restart]	This key is unavailable or has no effect when Sweep is set to Single . To restart a Single Sweep measurement, press [Single].

Adding a Marker

Markers can be used on traces to help you visually track up to four signals. Each marker has the following settings:

- **Type:** Provides three options, including:
 - **Off**
 - **Normal**, which places a diamond-shaped, colored marker, along with a number, 1-4, on the trace.
 - **Delta**, is associated with a normal marker. Therefore, a normal marker must exist prior to creating the delta marker. The delta marker displays the difference between the normal marker position and the delta marker position. Only one delta marker can be associated with a given normal marker. The normal marker must be active when Delta is selected.
- **Marker to Peak:** Places the active marker on the current greatest value of the trace.
- **Marker to Next Peak:** Places the active marker on the current second greatest value of the trace.
- **Marker to Min:** Places the active marker on the current lowest value of the trace.
- **Marker to Next Min:** Places the active marker on the current second lowest value of the trace.

Step	Notes
1 [Marker]	
2 [Marker]	
3 [1], [2], [3], or [4]	

Distance to Fault

Measuring Distance to Fault

Step	Notes
4	[Type]
5	[Off], [Normal], or [Delta]
6	Locate the marker relative to the trace: [Marker to Peak] or [Marker to Next Peak] or [Marker to Min] or [Marker to Next Min]

Setting the Pass/Fail Limits

The measurement limits setting enables you to alter the value of the upper limit. Limits are set in dB and are relative. The setting you choose defines the location of the limit line displayed on the screen. The setting affect the metrics color display: red represents fail, green represents pass.

To Set the Measurement Upper and Lower Limits:

Step	Notes
1	[Setup]
2	[Limits]
3	On [Limits] select On or Off . Enables you to toggle the measurement limits function On (active) and Off (inactive). <ul style="list-style-type: none">• If set to On, a limit line is displayed on the screen. Any measured value that exceeds the limit will result in a failure indication for that value.• If set to Off, neither a limit indicator is displayed nor is a pass fail indicator seen in the metrics display portion of the display.

Step	Notes
4 Set the upper limit.	Maximum Upper limit: Ref Level (top of display)
a. [Upper Limit]	Minimum Upper limit: bottom of display
b. Enter the number on the numeric keypad.	
c. [dB]	

Distance to Fault
Measuring Distance to Fault

- “Using the Spectrum Analyzer” on page 120
- “Performing a Basic Spectrum Analyzer Measurement” on page 121
- “Setting the Range Control” on page 124
- “Setting the Analyzer Input Gain” on page 126
- “Setting the Analyzer Detector” on page 127
- “Setting Up the Signal Generator” on page 128
- “Setting Average, Sweep, and Restart” on page 130
- “Changing the Resolution Bandwidth” on page 132
- “Adding or Removing a Marker” on page 132
- “Setting the Pass/Fail Limits” on page 135
- “Using the Spectrogram View” on page 142
- “Performing a Spectrogram Measurement” on page 143
- “Using the Interference ID Measurement” on page 145
- “Performing a Basic Interference ID Measurement” on page 145
- “Using the Occupied BW Measurement” on page 150
- “Performing a Basic Occupied BW Measurement” on page 151
- “Using the Spectrum Emission Mask Measurement” on page 156
- “Channel Standards and Emission Limits” on page 158
- “Performing a Basic Spectrum Emissions Mask Measurement” on page 159

Using the Spectrum Analyzer

Use the Spectrum Analyzer in direct connect mode to:

- Verify that your transmitted signal does not interfere (produce spurs and harmonics) with other signals.
- Verify spectral integrity—look at a signal to see if it meets expectations, look for unwanted signals.

Use the Spectrum Analyzer in Over Air mode to:

- Look for interference generated by other transmitters that can interfere with your transmit band.

CAUTION

To prevent damage in most situations when you directly couple the test set to a base station, use the **high power attenuator** between the test set and the BTS.

The maximum power for the RF In and RF Out/SWR port is 20 dBm (100 mW). The maximum power for the Power Sensor port is 24 dBm (300 mW). When directly coupled to a base station, the test set can be damaged by excessive power applied to any of these three ports.

NOTE

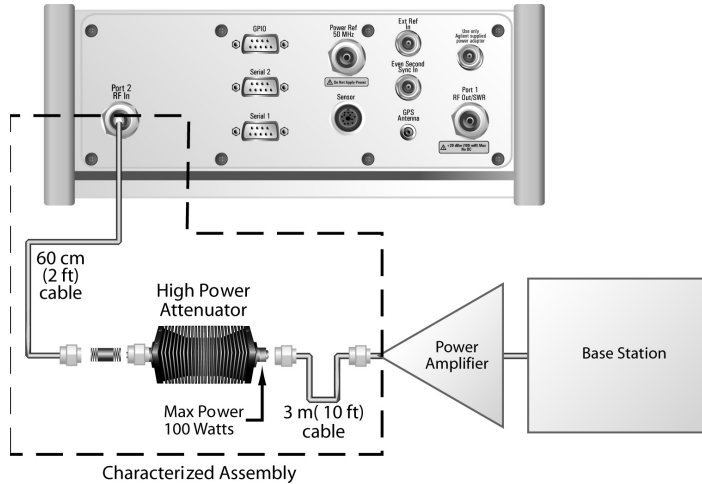
The RF In loss can be added manually, or automatically by performing an insertion loss measurement. For measurement instructions refer to [“Performing \(and Calibrating\) a Basic One Port Insertion Loss measurement”](#) on page 75 or [“Normalizing and Performing a Basic Two Port Insertion Loss Measurement”](#) on page 57.

Performing a Basic Spectrum Analyzer Measurement

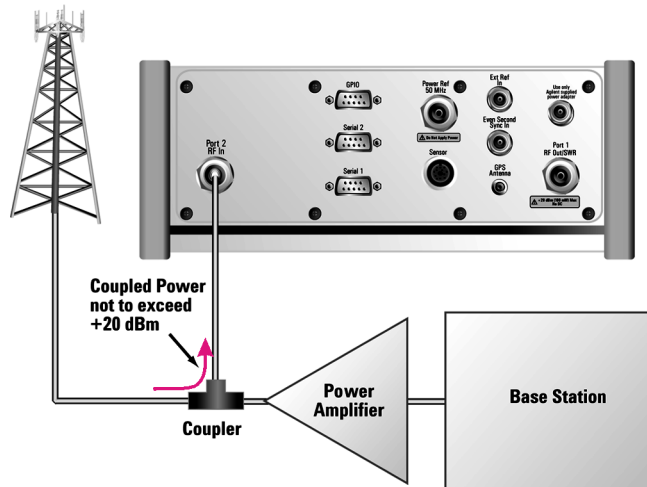
Step	Notes
1 Select Spectrum Analyzer. <ul style="list-style-type: none"> a. Mode b. [Spectrum Analyzer/Tools] c. [Spectrum Analyzer] 	
2 Enter the channel standard. <ul style="list-style-type: none"> a. [Freq/Chan] b. [Chan Std] c. Select the standard using the up and down arrow buttons. d. [Select] e. On [Units] select Chan. 	Each time you press the [Units] menu key, the selected option changes between Freq. (frequency) and Chan. (channel number).
3 Enter the channel number. <ul style="list-style-type: none"> a. [Channel] b. Enter the channel number using the numeric keypad. c. Select [Fwd] or [Rev]. 	
4 Set the span. <ul style="list-style-type: none"> a. [Span] b. Enter the frequency using the numeric keypad. c. [Hz], [kHz], [MHz], or [GHz] 	
5 Connect to the base station.	

Spectrum Analyzer Using the Spectrum Analyzer

Step	Notes
6	

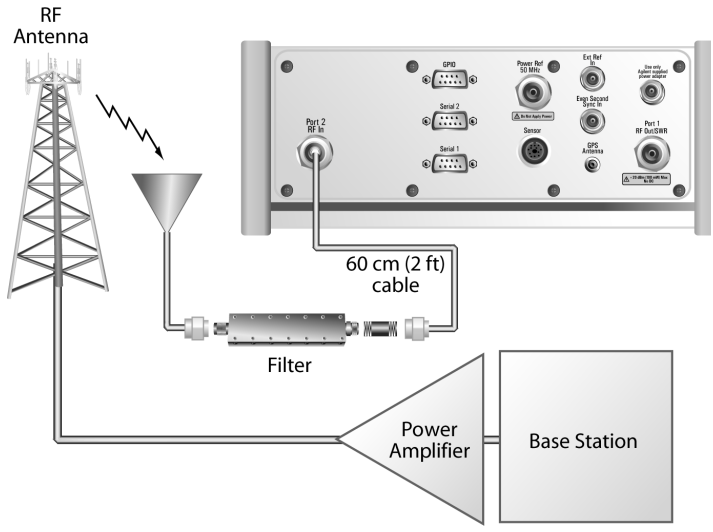


Out of service connection



Step	Notes
7 For an over the air measurement, connect an antenna and an external filter to the RF input.	The external filter is necessary to eliminate out-of-band signals that would otherwise reduce the dynamic range of measurements in the band of interest. The effect of the out-of-band signals is to raise the noise floor, possibly hiding some or all of the signal of interest.

8



Over the air measurement connection

- 9 Set the level to Autoscale.
 - a. [Level]
 - b. [Autoscale]

Spectrum Analyzer

Spectrum Analyzer

Using the Spectrum Analyzer

Step	Notes
10 (Recommended) Display a marker and set it to peak.	The marker value appears in the upper right.
a. [Marker]	Pressing [Marker] on the left menu displays the Marker menu on the right. Pressing Marker on the right menu selects your marker number. Marker numbers cycle from 1 to 2 to 3 to 4, and back again, each time you press this key.
b. [Marker]	
c. On [Type] select Normal .	
d. [Marker to Peak]	

Setting the Range Control

NOTE

The autoranging feature, which is built into the test set, helps ensure accurate measurements by changing front-end amplifier gain as needed when a strong signal threatens to overload the test set. When this occurs, the noise floor rises (as gain is decreased), then falls again when the strong signal stops. You should leave the range control in autorange for general use to ensure the accuracy of the measurement results.

If you prefer to use a fixed noise floor, you can disable autoranging in two ways using the [Setup], [Range Ctrl] function within Spectrum Analyzer:

- On [Range Ctrl] select **Hold** to fix the front-end amplifier gain at the current level. You may use [Range Up] or [Range Down] to change the noise floor. A word of caution: when you use the **Hold** setting, a subsequent strong signal—even outside the measurement range—may cause an inaccurate reading due to overloading the front-end of the test set. While in **Hold**, you can adjust the gain of the front-end amplifier with the **Range Up** and **Range Down** menu keys. The **Hold** setting cannot be saved. Leaving the measurement or going into the sleep mode will reset the Range Ctrl to **Auto**.
- On [Range Ctrl] select **Max** to fix the front-end amplifier gain at the current level until a strong signal comes in. When a strong signal is received, the front-end amplifier gain will be reduced to maintain accuracy, but it will not return to its lower level after the strong signal stops.

If the noise floor is too high to measure the signal of interest, reducing the resolution bandwidth will reduce the noise floor, at the expense of the measurement update

_____ rate.

Spectrum Analyzer

Using the Spectrum Analyzer

Using the Range Control Function:

Step	Notes
1	Set the Range Ctrl to Hold. a. [Setup] b. [Range Ctrl] c. On [Range Ctrl] select [Hold] Each time you press this softkey, the selected option changes. d. Select [Range Up] or [Range Down] Use the Range Up or Range Down menu keys to adjust the gain to ensure the accuracy of the measurement results.
2	Set the Range Ctrl to Max. For more information on the autoranging feature, refer to the note above. a. [Setup] b. [Range Ctrl] c. On [Range Ctrl] select [Max]

Setting the Analyzer Input Gain

Normally the E7495A/B is set to add the most gain in the receive path to boost low-level signals. If the signal is high, there is no reason to add gain. When you're measuring a strong signal, select low sensitivity to reduce the gain in the receive path and lower the noise floor. For a low level signal, select high.

Step	Notes
1	[Setup]

Step	Notes
2 [Sensitivity]	
3 Low or High	

NOTE

The Sensitivity setting is coupled to the Noise Correction setting. Changing the Sensitivity setting from **Low** to **High** will cause the Noise Correction setting to change from **On** to **Off**. Conversely, if the Noise Correction setting is changed from **Off** to **On**, the Sensitivity setting is changed from **High** to **Low**.

Setting the Analyzer Detector

You can set a detector mode for spectrum measurements.

Positive peak detection displays the highest sample level measured during each sampling period.

Sample detection displays the peak of CW-like signals and maximums and minimums of noise-like signals.

Negative peak detection displays the lowest sample level measured during each sampling period.

Average detection displays the average power in each frequency measured across the spectrum.

Step	Notes
1 [Setup]	
2 [Detector]	
3 [Peak], [Sample], [Negative Peak], or [Average]	

Setting Up the Signal Generator

You can set up the signal generator while in the Spectrum Analyzer mode from the Setup menu. For more detailed information on the signal generator setup and operation, refer to [“Using the Signal Generator” on page 200](#)

CAUTION

To prevent damage in most situations when you directly couple the test set to a base station, use the **high power attenuator** between the test set and the BTS.

The maximum power for the RF In and RF Out/SWR port is 20 dBm (100 mW). The maximum power for the Power Sensor port is 24 dBm (300 mW). When directly coupled to a base station, the test set can be damaged by excessive power applied to any of these three ports.

NOTE

The lowest level the signal generator can go to is -90 dBm. In order to get a lower level, you must use an external attenuator. You can compensate for the attenuator in the RF Out Loss.

Step	Notes
1	[Setup]
2	[Sig Gen]
3	[Freq/Chan]
4	Enter the channel number or the frequency using the numeric keypad.
5	<ul style="list-style-type: none">For channel select [Rev] or [Fwd]For frequency select [GHz], [MHz], [kHz], or [Hz],
6	[Mod Format]
7	Select the channel standard from the list using the up and down arrow buttons.

Step	Notes
8 [Select]	
9 Set the RF output amplitude	You may also enter a new value for amplitude by turning the rotary knob until the desired value is displayed or using the up and down arrow keys.
a. [Amplitude]	
b. Enter the amplitude value using the numeric keypad.	
c. [dBm].	
10 If you have previously stored RF Out Loss from an insertion loss measurement, go to the next step.	For information on the effects of the RF Out Loss function on the amplitude, refer to “Using the RF OUT Loss field,” below.
Or	Each time you press this softkey, the selected option changes.
Press [RF OUT Loss] to select On and enter the RF Out Loss value.	
11 Connect to the base station.	
12 On [Enable Sig Gen] select On .	Each time you press this softkey, the selected option changes.

Using the RF OUT Loss field

The RF OUT Loss field is used when you need to test the receiver sensitivity of a typical base station. The test set’s source will typically go down to -95 dBm, so in order to reach -113 dBm for sensitivity testing, you must use an external pad. The measured value of the pad and connecting cables are entered into this field. This value is then used when this field is set to **On**. When this field is set to **On**, the test set will set the RF generator level to the correct level offset by the external pad/cabling. When you set the RF Generator to -113 dBm (with the RF OUT Loss field turned **On** and the external pad/cabling loss value entered) the output at the end of the RF test cabling is -113 dBm.

Example: If you want to set the signal generator to -113 dBm, the pad and RF cabling measures 42.51 dB (measured with the 2 port insertion loss measurement screen prior to this test), the RF OUT Loss field is turned **On** (with the 42.51 dB loss value entered). The actual RF output of the signal generator is -70.49 dBm, the pad

Spectrum Analyzer

Using the Spectrum Analyzer

and RF cabling attenuated the signal to the desired level; so the RF signal at the end of the test cable/pad is -113 dBm. This also points out the importance of accurately measuring the loss of the pad and connecting cables.

Setting Average, Sweep, and Restart

Setting the Sweep

You can select either continuous or single sweep. Continuous sweep provides repeated, ongoing measurements. Single sweep performs a single measurement that is repeated only when you push the Single button.

To set sweep:

Step	Notes
1 [Average/Sweep]	
2 [Continuous] or [Single]	Each time you press one of these softkeys, the selected option changes.

Setting Averaging

You can choose to have averaging on or off and set the number of averages you want to take. You can select from the following types of averaging:

- **Off:** Disables averaging.
- **Running:** Computes the new result as the weighted sum of the last result and the new measurement. The last result is weighted by $(n - 1)/n$. The new result is weighted by $1/n$. Each new measurement produces a new result.
- **Max Hold:** Is not an average, but on a point by point basis, displays the maximum amplitude for the given frequency or channel since Max Hold was turned on. It is updated when a new maximum occurs.
- **Group Average:** Makes the requested number of measurements, averages the measurement data, and displays the average as a single result trace. Measurement time will vary based on the requested number of averages and can take minutes for very large number of averages.
- **Group Max Average:** Makes the requested number of measurements before returning a single trace result. This trace is the maximum value seen at each trace point over the requested number of averages (measurements).

To set averaging:

Step	Notes
1	Set the number of averages. <ol style="list-style-type: none"> a. [Average] b. Enter the number of averages using the numeric keypad. c. [Enter]
2	Select the type of averaging you want to apply. <ol style="list-style-type: none"> a. [Average/Sweep] b. [Averaging] c. [Off], [Running Average], [Max Hold], [Group Average], or [Group Max Average]

NOTE

These two steps can be performed in any order. However, if you turn averaging on and a large number of averages has previously been set, there may be a delay before you can change number of averages.

Setting Restart

When you have averaging turned **On** and you are in **Continuous** Sweep mode, you can restart the averaging by pressing the Restart menu key. The Restart key has no effect if you are in **Single** sweep mode.

To restart averaging:

Step	Notes
1	[Average/Sweep]
2	[Restart] <p>This key is unavailable or has no effect when Sweep is set to Single. To restart a Single Sweep measurement, press [Single].</p>

Changing the Resolution Bandwidth

The default resolution bandwidth is 0.1% of the span in Auto mode. By selecting Manual, you can define a narrower bandwidth and thereby see spurious signals that you might miss in Auto mode. However, the measurement will be slower.

NOTE

The auto mode is appropriate for most measurements. When you set the Res BW to **Manual**, you must remember to change the Res BW whenever you change the span. Otherwise, the measurement may take longer than expected or will not have the expected accuracy and or resolution.

Furthermore, if you set the span greater than 1 MHz, the maximum resolution bandwidth allowed is 1% of the span. For example, if you set the span to 20 MHz, the maximum resolution bandwidth will be 200 kHz.

Step	Notes
1 [Setup]	
2 On [Res BW] select Manual .	Each time you press this softkey, the selected option changes. In Auto mode, the resolution bandwidth is coupled to the span setting, Manual mode decouples the resolution bandwidth from the span.
3 Enter the bandwidth using the numeric keypad.	
4 [Hz] or [kHz]	

Adding or Removing a Marker

Markers can be used on traces to help you visually track up to four signals. Each marker has the following settings:

- **Type:** Provides three options, including:
 - **Off**
 - **Normal**, which places a diamond-shaped, colored marker, along with a number, 1-4, on the trace.
 - **Delta**, is associated with a normal marker. Therefore, a normal marker must

exist prior to creating the delta marker. The delta marker displays the difference between the normal marker position and the delta marker position. Only one delta marker can be associated with a given normal marker. The normal marker must be active when Delta is selected.

- **Marker to Peak:** Places the active marker on the current greatest value of the trace. This key is only enabled when your currently selected marker is of type Normal or Delta.
- **Marker to Next Peak:** Places the active marker on the current next greatest value of the trace. This key is only enabled after you have performed a Marker to Peak search, and when the currently selected marker is of type Normal or Delta.
- **Center Freq to Marker:** Changes the center frequency to locate the current marker in the center of the trace.
- **Ref Level to Marker:** Scrolls the trace to place the marker at the top of the screen. To reset the reference level, choose [Level/Location] [Autoscale].

To Add a Marker to a Trace:

Step	Notes
1 [Marker]	
2 [Marker]	Press [Marker] repeatedly to select Marker 1, 2, 3, or 4.
4 [Type]	
5 [Normal] or [Delta]	
6 Locate the marker relative to the trace:	<ul style="list-style-type: none"> • [Marker to Peak] • [Marker to Next Peak]
7 Locate the trace relative to the marker:	<ul style="list-style-type: none"> • [Center Freq to Marker] • [Ref Level to Marker]

Spectrum Analyzer

Using the Spectrum Analyzer

To Remove a Marker from a Trace:

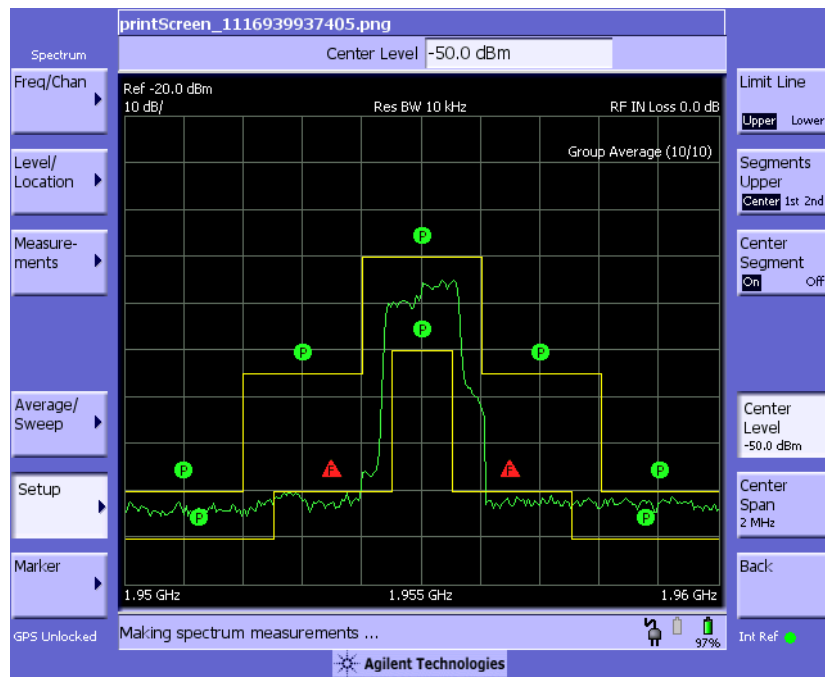
Step	Notes
1 [Marker]	
2 [Marker]	Press [Marker] repeatedly to select Marker 1, 2, 3, or 4.
4 [Type]	
5 [Off]	

Setting the Pass/Fail Limits

The measurement limits setting allows you to alter the value of the upper and lower test limits. Center segment limits are set in dBm and are absolute limit values. The first and second segment limit values are set in dB and are limit values relative to the center segment. The settings you choose define the location of the limit lines displayed on the screen. These settings will result in a pass/fail flag being displayed on the screen above the limit line: a red triangle with a “F” is a fail, a green circle with a “P” is a pass.

You can set a variety of limit configurations to suit your needs: a single upper or lower limit, an upper and lower limit pair (see [Figure 6-2](#)), a segmented upper or lower limit, or an upper and lower segmented limit mask (see [Figure 6-1](#)). You can specify a maximum of one centre segment, two lower segments, and two upper segments.

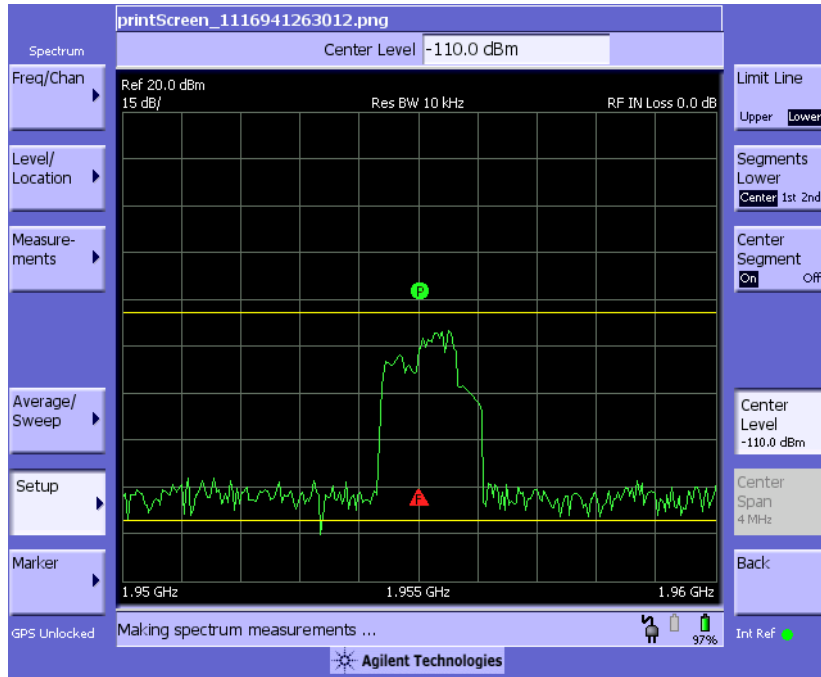
Figure 6-1 Segmented Limit Mask



Spectrum Analyzer

Spectrum Analyzer Using the Spectrum Analyzer

Figure 6-2 Limit Lines Upper & Lower



To Set the Measurement Upper and Lower Limits:

Step	Notes
1 [Setup]	
2 [Limits]	
3 Set the upper limit. a. On [Limits] select Upper	
4 Set the center segment limit. a. On [Segments] select Center	
5 On [Center Segment] select On or Off .	<p>Enables you to toggle the measurement limit line segment function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> • If set to On, an upper limit line with a pass or fail icon above the line is displayed on the screen. This enables you to set the center segment limit value and the width of the center segment. (Center segment width (Center Span) is unavailable unless the first segment is turned on.) Any measured value that exceeds the upper limit will result in a failure indication. • If set to Off, neither limit lines nor pass fail indicators are displayed.
6 Set the center segment limit value. a. [Center Level] b. Enter the number on the numeric keypad. c. [dBm]	<p>Maximum Upper limit: 50 dBm to –150 dBm (if a lower limit is set, the upper limit should be set higher than the lower limit)</p>

Spectrum Analyzer

Using the Spectrum Analyzer

Step	Notes
7	<ul style="list-style-type: none">• If you only need an upper limit line, stop here.• If you need a lower limit line:<ol style="list-style-type: none">a. On [Limits] select Lowerb. Repeat steps 4, 5, and 6.• For a segmented limit line, proceed with step 8.
8	<p>Set the first segment limit.</p> <ol style="list-style-type: none">a. On [Segments] select 1st
9	<p>On [1st Segment] select On or Off.</p> <p>Enables you to toggle the measurement limit line segment function On (active) and Off (inactive).</p> <ul style="list-style-type: none">• If set to On, a left and right upper limit line segment with a pass or fail icon above each segment is displayed on the screen. This enables you to set the first segment left and right limit values and the width of the left and right first segment. (The first segment width (Span) is unavailable unless the second segment is turned on.) Any measured value that exceeds the upper limit will result in a failure indication.• If set to Off, neither limit lines nor pass fail indicators are displayed. Nor are second segment functions available.

Step	Notes
<p>10 Set the first segment left and right limit values.</p> <p style="margin-left: 20px;">a. On [1st Segment] select Left.</p> <p style="margin-left: 20px;">b. [Level]</p> <p style="margin-left: 20px;">c. Enter the number on the numeric keypad.</p> <p style="margin-left: 20px;">d. [dB]</p> <p style="margin-left: 20px;">e. On [1st Segment] select Right.</p> <p style="margin-left: 20px;">f. Repeat steps b, c, and d.</p>	<p>Maximum Upper limit: 50 dBm to –150 dBm (if a lower limit is set, the upper limit should be set higher than the lower limit)</p>
<p>11 Set the center segment width value.</p> <p style="margin-left: 20px;">a. On [Segments] select Center</p> <p style="margin-left: 20px;">b. [Center Span]</p> <p style="margin-left: 20px;">c. Enter the number on the numeric keypad.</p> <p style="margin-left: 20px;">d. [GHz], [MHz], [kHz], or [Hz]</p>	
<p>12</p> <ul style="list-style-type: none"> • If you only need a two segment limit line, stop here. • For a three segment limit line, proceed with step 13. 	
<p>13 On [Segments] select 2nd</p>	

Spectrum Analyzer

Using the Spectrum Analyzer

Step	Notes
14 On [2 nd Segment] select On or Off .	<p>Enables you to toggle the measurement limit line segment function On (active) and Off (inactive).</p> <ul style="list-style-type: none">• If set to On, a left and right upper limit line segment with a pass or fail icon above each segment is displayed on the screen. This enables you to set the second segment left and right limit values. Any measured value that exceeds the upper limit will result in a failure indication.• If set to Off, neither limit lines nor pass fail indicators are displayed.
15 Set the second segment left and right limit values.	<p>Maximum Upper limit: 50 dBm to -150 dBm. If a Lower Limit is set, the Upper Limit should be set higher than the Lower Limit)</p>
a. On [2 nd Segment] select Left .	
b. [Level]	
c. Enter the number on the numeric keypad.	
d. [dB]	
e. On [2 nd Segment] select Right .	
f. Repeat steps b, c, and d.	

Step	Notes
16	Set the first segment width value. <ol style="list-style-type: none">On [Segments] select 1st[Span]Enter the number on the numeric keypad.[GHz], [MHz], [kHz], or [Hz],
17	Set the lower limit. <ol style="list-style-type: none">On [Limits] select LowerRepeat steps 4 through 16 as appropriate for the number of segments you need.

Using the Spectrogram View

The Spectrogram view requires that the Interference Analysis Option (Opt 270) is installed in your instrument. It can be used with the Interference ID or the Occupied BW measurements and standard spectrum. Troubleshooting a transmitter system is often aided by examining the time evolution of the power distribution.

This view provides a history of the spectrum. You can use it to:

- locate intermittent signals.
- track signal levels over time.

You may set the following parameters for this view:

- **Capture Interval:** Allows you to set the capture interval to 1 or more seconds. You can select any whole integer number of seconds as the Capture Interval. Alternatively, you may set it to **Max Speed**, which automatically determines the capture interval that provides the maximum data collection rate, and consequently the maximum Spectrogram display speed.

A data sample is taken every n^{th} trace for display on the spectrogram. Increasing the capture time allows data capturing over a longer period of time in the spectrogram. However, it is a sampling technique that allows intermittent events, which may occur between samplings, to be lost. Therefore, if you are searching for intermittent signals, consider using Group Max average type (see [“Setting Average, Sweep, and Restart” on page 130](#)) in conjunction with increasing the capture time.

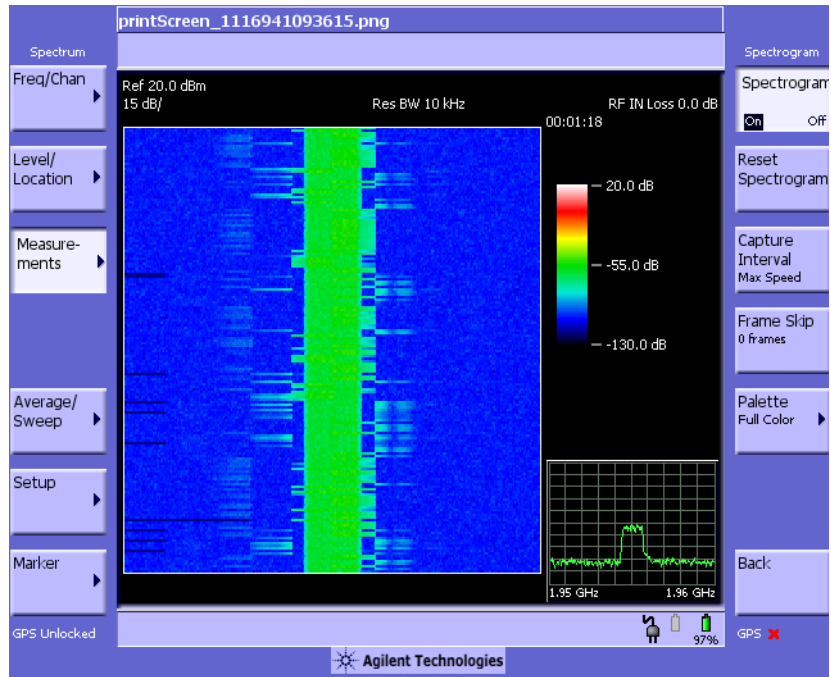
- **Frame Skip:** Allows you to set the number of frames you would like to skip when capturing data. You may set this value from skip 0 to 2147,483,647 frames. Increasing the frame skip value causes the display to redraw the spectrum every n^{th} trace and a block of lines is shown at once instead of a single line at a time. Higher frame skip values are for use with fast measurements.
- **Palette:** Allows you to set the display to full color or grayscale.

Performing a Spectrogram Measurement

Step	Notes
1 [Spectrum Analyzer]	
2 [Measurements]	
3 [Spectrogram]	
4 On [Spectrogram] select On .	
5 If you need to restart the data capture press [Reset Spectrogram]	
6 If desired set the capture interval: <ul style="list-style-type: none"> a. [Capture Interval] b. Enter the interval number using the numeric keypad. c. Select [sec] or [Max Speed]. 	[Max Speed] displays every trace captured.
7 If desired set the number of frames you want to skip: <ul style="list-style-type: none"> a. [Frame Skip] b. Enter the interval number using the numeric keypad. c. Select [frames]. 	
8 If desired set the display color: <ul style="list-style-type: none"> a. [Palette] b. Select [Full Color] or [Grayscale]. 	The color/grayscale top and bottom mappings are determined by the Ref Level and Scale/Div settings. To change the mapping, go to [Level/Location] and change [Ref Level] and [Scale/Div].

Spectrum Analyzer Using the Spectrogram View

Figure 6-3 Spectrogram View of a 1xEV-DO Signal



Using the Interference ID Measurement

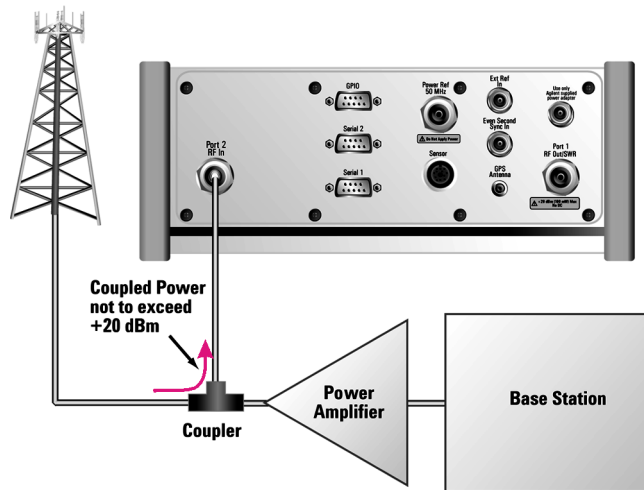
Use the Interference ID measurement to find and identify interference signals over a designated spectrum. This measurement requires that the Interference Analysis Option (Opt 270) be installed on your instrument. Interference ID provides you with a list of possible signal types for a designated signal. For example, a selected interference signal might be indicated as a possible CW or a CDMA signal. This measurement does not demodulate the signals. Therefore the list is not definitive. The list retains some history to help identify intermittent signals. The history can be reset with the [Average] [Restart] menu keys.

Performing a Basic Interference ID Measurement

Step	Notes
1 Select Spectrum Analyzer. <ul style="list-style-type: none"> a. Mode b. [Spectrum Analyzer/Tools] c. [Spectrum Analyzer] 	
2 Enter the channel standard. <ul style="list-style-type: none"> a. [Chan Std] b. Select the standard using the up and down arrow buttons. c. [Select] d. On [Units] select Chan. 	Each time you press the [Units] menu key, the selected option changes.
3 Enter the channel number. <ul style="list-style-type: none"> a. [Channel] b. Enter the channel number using the numeric keypad. c. Select [Fwd] or [Rev]. 	

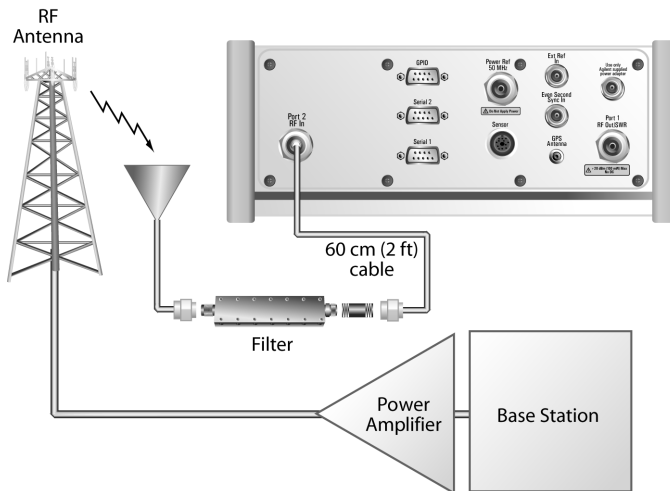
Spectrum Analyzer Using the Interference ID Measurement

Step	Notes
4	Set the span. a. [Span] b. Enter the frequency using the numeric keypad. c. [Hz], [kHz], [MHz], or [GHz]
5	Connect to the base station.



Connect to the Antenna

Step	Notes
6 For an Over The Air measurement, connect an antenna and an external filter to the RF input.	<p>The external filter is necessary to eliminate out-of-band signals that would otherwise reduce the dynamic range of measurements in the band of interest. The effect of the out-of-band signals is to raise the noise floor, possibly hiding some or all of the signal of interest. However, the external filter is optional in this set up:</p> <ul style="list-style-type: none"> • If you want to limit your search to a specific band of interest, then you should use the external filter. • If you want to search beyond a specific band, then you can leave the filter off.



Over the air measurement connection

Spectrum Analyzer

Spectrum Analyzer

Using the Interference ID Measurement

Step	Notes
7	<p>Set the level to Autoscale.</p> <ol style="list-style-type: none"> [Level] [Autoscale]
8	<p>Select the Interference ID Measurement.</p> <ol style="list-style-type: none"> [Measurements] [Interference ID] On [Interference ID] select On. <p>A marker will appear on the trace at the left of the display. The Frequency and power level at the marker (Signal Pointer) is displayed in the data window below the trace display window. The type of signal that is causing the interference is also indicated.</p>
9	<p>You can set marker to a signal peak by:</p> <ol style="list-style-type: none"> [Signal Pointer] Enter the frequency using the numeric keypad. Select [GHz], [MHz], [kHz], or [Hz]. <p>OR by:</p> <ol style="list-style-type: none"> [Pointer to Peak] Enter the frequency using the numeric keypad. Select [Pointer To Next Peak] to mark successively lower peaks. <p>The number displayed at the bottom of the Pointer to Peak button indicates the number of the marked peak and the total number of peaks. For example, 1/22 indicates the peak with the highest power on the display and a total of 22 peaks displayed. 2/22 would indicate the second highest peak, 3/22 the third highest, and so forth.</p> <p>Pointer to Peak always returns the marker to the highest peak.</p>

Step	Notes
<p>10 You can set the threshold level to automatically set value or manual select a value by:</p> <p style="margin-left: 20px;">a. On [Threshold] select Auto</p> <p style="margin-left: 40px;">Or</p> <p style="margin-left: 20px;">a. On [Threshold] select Manual</p> <p style="margin-left: 20px;">b. Enter the threshold value using the numeric keypad.</p> <p style="margin-left: 20px;">c. Select [dBm].</p>	<p>The threshold limit line is displayed on the graticule at the desired level. Ensure that the threshold value you enter is within the graticule range or the threshold limit line will be off the display.</p> <p>The threshold is used to determine the “edges” of the signal. Manual adjustment may be required to correctly identify some signals, especially in crowded spectrums.</p>
<p>11 You can set center frequency of the display to the marker frequency by:</p> <p style="margin-left: 20px;">a. [Zoom to Signal]</p> <p style="margin-left: 20px;">b. [Zoom In]</p>	<p>The marker will track with the new center frequency at the center of the display. The Span will be decreased to enhance viewing of the designated interference signal.</p>
<p>12 Under [Zoom to Signal] you may also select [Zoom Out]</p>	<p>[Zoom Out] will back out the [Zoom In] series. If you Manually set the Frequency/Channel or Span, it will clear the [Zoom Out] history.</p>

Using the Occupied BW Measurement

Occupied Bandwidth integrates the power of the displayed spectrum and puts markers at the frequencies between which a selected percentage of the power is contained. The measurement defaults to 99% of the occupied bandwidth power. The power-bandwidth routine first computes the combined power of all signal responses contained in the trace. For 99% occupied power bandwidth, markers are placed at the frequencies on either side of 99% of the power. This would leave 1% of the power evenly distributed outside the markers. The difference between the marker frequencies is the 99% power bandwidth and is the value displayed.

The Occupied BW result will correspond to the span between the two markers and will be a multiple of the span between two points. So, for a 10 MHz span, the OBW will come in multiples of 39.216 kHz (10 MHz divided by 255). Values will be 0, 39.216 kHz, 78.431 kHz, 117.647 kHz, and so forth. For narrow signals (TDMA, PDC, and so forth) you will need to zoom in on the signal to get a reasonably accurate Occupied BW result. For a 100 kHz span the Occupied BW resolution will be 392 Hz (100 kHz divided by 255).

The occupied bandwidth measurement can be made in single or continuous sweep mode. The center frequency and reference level may be set by you.

Performing a Basic Occupied BW Measurement

NOTE

The E7495A/B defaults to Average (RMS) detection to measure the occupied bandwidth power. Average (RMS) detection gives the most accurate results, so the default detector setting should therefore be maintained for OBW measurements. Sample detection will give similar results to the Average (RMS) detection, although the results will be less repeatable. Peak and Negative Peak detection will give higher and lower results, respectively, from the actual power.

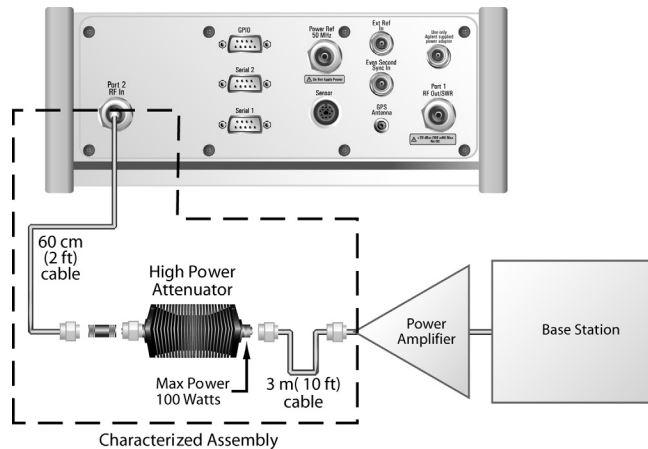
To reproduce repeatable power readings, use the default Average (RMS) detector. In addition, you should use Running Average or Group Average with 50 or more averages. For more details on averaging, see [“Setting Average, Sweep, and Restart” on page 130](#).

Step	Notes
1 Select Spectrum Analyzer. a. Mode b. [Spectrum Analyzer/Tools] c. [Spectrum Analyzer]	
2 Enter the channel standard. a. [Chan Std] b. Select the standard using the up and down arrow buttons. c. [Select] d. On [Units] select Chan .	Each time you press the [Units] menu key, the selected option changes.
3 Enter the channel number. a. [Channel] b. Enter the channel number using the numeric keypad. c. Select [Fwd] or [Rev].	

Spectrum Analyzer

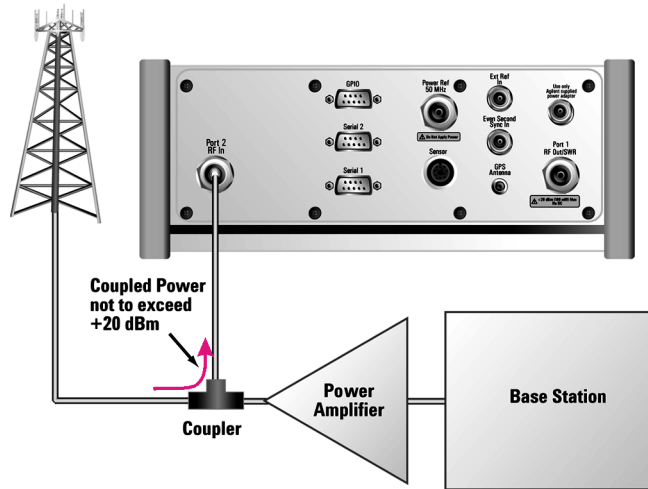
Using the Occupied BW Measurement

Step	Notes
4	Set the span.
a.	[Span]
b.	Enter the frequency using the numeric keypad.
c.	[Hz], [kHz], [MHz], or [GHz]
5	Turn on Averaging.
a.	[Span]
b.	Enter the frequency using the numeric keypad.
c.	[Hz], [kHz], [MHz], or [GHz]
6	Connect to the base station.



Out of service connection

Step	Notes
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In service connection

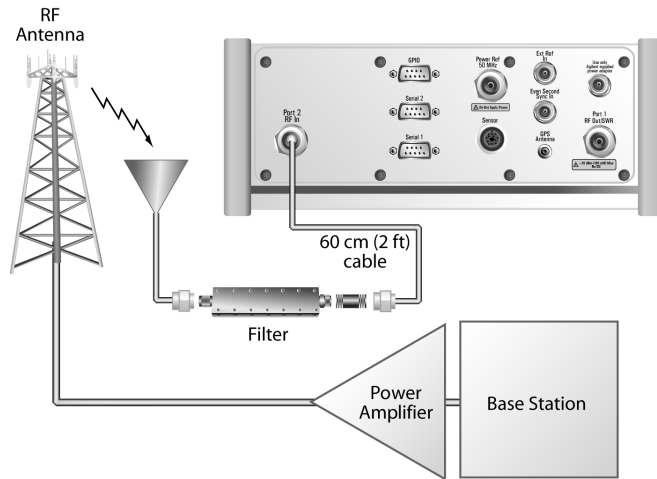
- 7 For an over the air measurement, connect an antenna and an external filter to the RF input.

The external filter is necessary to eliminate out-of-band signals that would otherwise reduce the dynamic range of measurements in the band of interest. The effect of the out-of-band signals is to raise the noise floor, possibly hiding some or all of the signal of interest. However, the external filter is optional in this set up:

- If you want to limit your search to a specific band of interest you should use it
- If you want to search beyond a specific band then can leave the filter off.

Spectrum Analyzer Using the Occupied BW Measurement

Step	Notes
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Over the air measurement connection

- 8 Set the level to Autoscale.
 - a. [Level]
 - b. [Autoscale]
- 9 Select the Occupied BW Measurement. A marker pair will appear on the trace and the occupied bandwidth value and the integrated power in the Occupied BW are displayed in the data window below the trace graticule.
 - a. [Measurements]
 - b. [Occupied BW]
 - c. On [Occupied BW] select **On**.
- 10 Set the percentage of power for calculating the Occupied BW. The default percentage is 99%.
 - a. [Power]
 - b. Enter the percentage number using the numeric keypad.
 - c. Select [%].

Step	Notes
11 If you are measuring a narrow signal such as TDMA or PDC, zoom in on the signal for a more accurate Occupied BW results. a. [Freq/Chan/Span] b. [Span] c. Enter the frequency using the numeric keypad. d. [Hz], [kHz], [MHz], or [GHz]	

Using the Spectrum Emission Mask Measurement

Use the Spectrum Emission Mask (SEM) measurement (also sometimes referred to as Conducted Spurious Emissions measurement) to identify and determine the power levels of spurious emissions outside the assigned CDMA channel. The measurement is made at the access network output port or at the repeater RF output port.

The SEM measurement only supports the cdma2000 and the 1xEV-DO channel standards, covering band classes 0,1,3,4,5,6, and 10. If you enable the SEM measurement using an unsupported channel standard, the limit mask will not be turned on and a message will be displayed telling you that SEM Measurements do not support your selected channel standard. The table below summarizes supported and unsupported channel standards:

Band Class	Band Name	Channel Standard Name	SEM Measurements Supported?
0	800 MHz Band.	North American Cellular CDMA (commonly referred to as, 'Cellular Band')	Yes
1	1900 MHz Band	North American PCS CDMA (commonly referred to as, "PCS").	Yes
2	TACS Band	TACS CDMA	SEM Not Supported
3	JTACS Band	Japan CDMA	Yes
4	Korean PCS Band.	Korean PCS CDMA	Yes
5	450 MHz Band	NMT-450	Yes
6	2 GHz Band	IMT-2000 cdma2000	Yes
7	700 MHz Band:	North American 700 MHz Cellular CDMA	SEM Not Supported
8	1800 MHz Band	1800 MHz CDMA	SEM Not Supported

Band Class	Band Name	Channel Standard Name	SEM Measurements Supported?
9	900 MHz Band	900 MHz CDMA	SEM Not Supported
10	Secondary 800 MHz Band	Secondary 800 CDMA	Yes
11	400 MHz European PAMR Band	400 MHz European PAMR	SEM Not Supported
12	800 MHz PAMR Band	800 MHz PAMR	SEM Not Supported

NOTE

SEM measurements are made under two conditions. These are:

- Continuous Data mode, that is, with no idle slots.
- Idle mode, that is, with all slots idle except the control channel

Your E7495A or E7495B test instrument can only make SEM measurements for the first condition, that is, in Continuous Data mode

To make an SEM measurement, the power level limits at different frequency offsets need to be specified. These power limits vary between different channel standards, but have all been predefined for you. These limits are listed in the table below.

For all possible channel standards for which you can make an SEM measurement (see the table above), the power limits have been predefined and will be displayed on the screen as a stepped yellow line. This line is known as the ‘mask’. If you attempt to make an SEM measurement for a channel standard that does not support SEM measurements, no mask will be displayed, and the message, “SEM Measurement does not support the selected Channel Standard” will be displayed on the bottom of the test instrument’s screen.

Channel Standards and Emission Limits

Band Class	Band Name	Frequency Variance	Emission Limit / RBW
0	800 MHz Band.	750 kHz to 1.98 MHz	-45 dBc / 30 kHz
		1.98 MHz to 4.00 MHz	-60 dBc / 30 kHz
1	1900 MHz Band	885 kHz to 1.98 MHz	-45 dBc / 30 kHz
		1.98 MHz to 2.25 MHz	-55 dBc / 30 kHz
2	TACS Band	SEM Not Supported	
3	JTACS Band	750 kHz to 1.98 MHz	-45 dBc / 30 kHz
		1.98 MHz to 4.00 MHz	-60 dBc / 30 kHz
4	Korean PCS Band.	885 kHz to 1.98 MHz	-45 dBc / 30 kHz
		1.98 MHz to 2.25 MHz	-55 dBc / 30 kHz
5	450 MHz Band	750 kHz to 1.98 MHz	-45 dBc / 30 kHz
		1.98 MHz to 4.00 MHz	-60 dBc / 30 kHz
6	2 GHz Band	885 kHz to 1.98 MHz	-45 dBc / 30 kHz
		1.98 MHz to 2.25 MHz	-55 dBc / 30 kHz
7	700 MHz Band:	SEM Not Supported	
8	1800 MHz Band	SEM Not Supported	
9	900 MHz Band	SEM Not Supported	
10	Secondary 800 MHz Band	750 kHz to 1.98 MHz	-45 dBc / 30 kHz
		1.98 MHz to 4.00 MHz	-60 dBc / 30 kHz
11	400 MHz European PAMR Band	SEM Not Supported	
12	800 MHz PAMR Band	SEM Not Supported	

Performing a Basic Spectrum Emissions Mask Measurement

Step	Notes
1	Select Spectrum Analyzer. a. Mode b. [Spectrum Analyzer/Tools] c. [Spectrum Analyzer]
2	Enter the channel standard. a. [Chan Std] b. Select the standard using the up and down arrow buttons. c. [Select] d. On [Units] select Chan . Each time you press the [Units] menu key, the selected option changes.
3	Enter the channel number. a. [Channel] b. Enter the channel number using the numeric keypad. c. Select [Fwd] or [Rev].
4	Select the SEM measurement. a. [Measurements] b. [SEM]

Step	Notes
5	Switch the SEM measurement On.
a.	[SEM]
	<p>Each time you press the [SEM] menu key, the selected option changes.</p> <p>As soon as you switch the SEM measurement On, the SEM mask (a stepped yellow line) will appear on the screen. If no SEM mask appears, check that SEM measurements are supported for your selected channel standard.</p> <p>Each individual mask line segment will be annotated with either a green circle with 'P' inside it (indicating that the limit line segment has not been exceeded) or with a red triangle with an 'F' (indicating the limit has been exceeded and the test has failed).</p>

When the SEM Measurement is turned **On**, the states of the following parameters are stored for restoration when the SEM Measurement is turned **Off**:

- Resolution bandwidth mode
- Frequency span
- Averaging mode
- Number of averages
- Upper limits
- Lower limits

The following parameters are then set to perform the measurement. Each time the SEM measurement is turned **On**, these parameters are set to the values as detailed below. In addition the upper limits are reset to appropriate default values when the SEM measurement is **On** and the selected channel standard is changed.

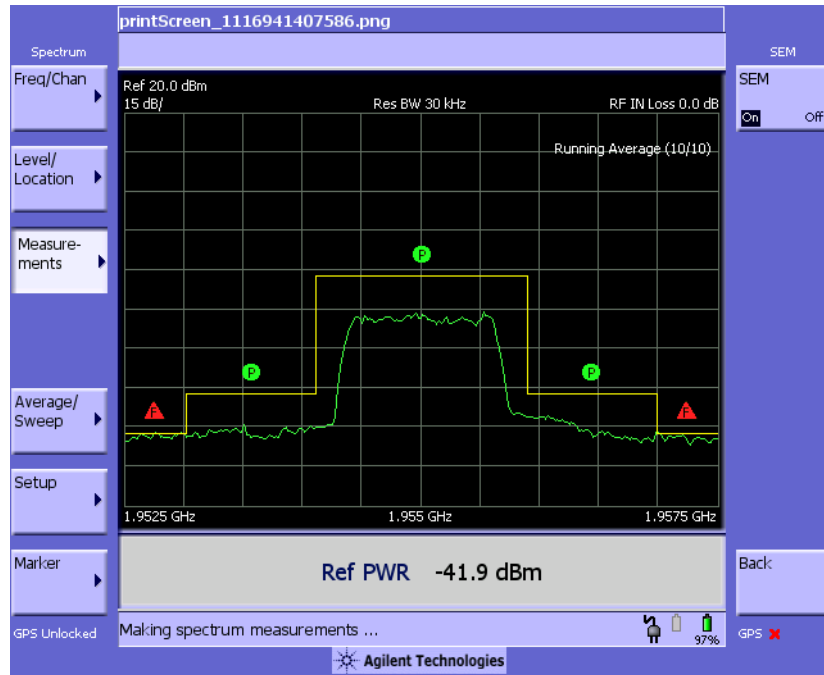
- **Occupied bandwidth** measurement turned **Off**
- **Interference analysis** measurement turned **Off**

- **Resolution bandwidth mode** set to **Manual**
- **Resolution bandwidth** set to **30 kHz**
- **Lower limit center**, segment 1 and segment 2 set to **Off**
- **Number of averages** set to **10**
- **Averaging mode** set to **Running**
- If currently selected channel standard is **Band class 0, 2, 3, 5, 7, 9** or **10** (see table above)
 - **Span** set to **8 MHz**
- If currently selected channel standard is **Band class 1, 4, 6** or **8**
 - **Span** set to **5 MHz**
- Upper limits are set to the levels specified in the table above.

The SEM Measurement is turned **Off** when either the Occupied Bandwidth or Interference Analysis measurements are turned **On**.

Spectrum Analyzer Using the Spectrum Emission Mask Measurement

Figure 6-4 Spectrum Emissions Mask (SEM) Measurement



“Using the Channel Scanner” on page 164

“Performing a Basic Channel Scanner Measurement” on page 165

“Displaying Accurate Peak Power (Recommended for Pulsed Signals)” on page 168

“Setting the Analyzer Input Gain” on page 169

“Setting Noise Correction” on page 169

“Entering the Channels with a List Instead of a Range” on page 170

“Entering the Channel Power Measurement Bandwidth and Time” on page 171

“Setting Average, Sweep, and Restart” on page 174

“Displaying Frequency or Power” on page 176

“Setting the Pass/Fail Limits” on page 176

Using the Channel Scanner

The Channel Scanner measures the power of multiple transmitted signals. It is most useful for measuring channel power in TDMA, GSM, AMPS, and iDEN channel bands. Channel power may be measured on a single channel or across multiple channels or frequencies. The Channel Scanner can be used to measure TDMA, AMPS, GSM and iDEN adjacent channel power.

CAUTION When measuring multiple channels, the combined channel power must not exceed +20 dBm at the RF In port.

CAUTION The maximum power for the RF In and RF Out/SWR port is 20 dBm (100 mW). The maximum power for the Power Sensor port is 24 dBm (300 mW). When directly coupled to a base station, the test set can be damaged by excessive power applied to any of these three ports.

To prevent damage in most situations when you directly couple the test set to a base station, use the high power attenuator between the test set and the BTS.

NOTE For complex modulation such as CDMA, W-CDMA, 1xEV-DO and GSM, the frequency error measurement is not accurate (see respective analyzers for detailed frequency error results).

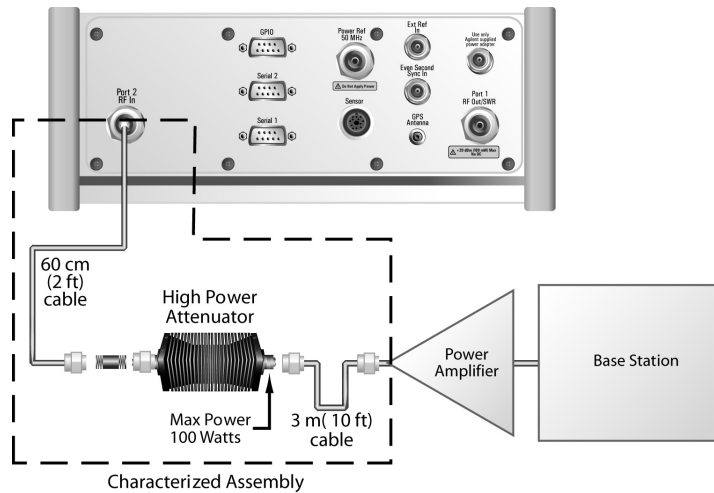
NOTE The RF In Loss can be added manually or automatically by performing an insertion loss measurement. For measurement instructions refer to [“Performing \(and Calibrating\) a Basic One Port Insertion Loss measurement”](#) on page 75 or [“Normalizing and Performing a Basic Two Port Insertion Loss Measurement”](#) on page 57.

Performing a Basic Channel Scanner Measurement)

Step	Notes	
1	Select Channel Scanner.	
	<ul style="list-style-type: none"> a. Mode b. [Spectrum Analyzer/Tools] c. [Channel Scanner] 	
2	Select the channel standard.	
	<ul style="list-style-type: none"> a. [CS Chan Std] b. Select the standard using the up and down arrow buttons. c. [Select] 	
3	On [CS Units] select Chan .	Each time you press this softkey, the selected option changes.
4	On [Scan Mode] select Range .	Each time you press this softkey, the selected option changes.
5	Select the start channel.	
	<ul style="list-style-type: none"> a. [Start Chan] b. Enter the start channel using the numeric keypad. c. [Fwd] or [Rev] 	
6	Enter the CS step size.	
	<ul style="list-style-type: none"> a. [CS Step Size] b. Enter the step size using the numeric keypad. c. [Enter] 	

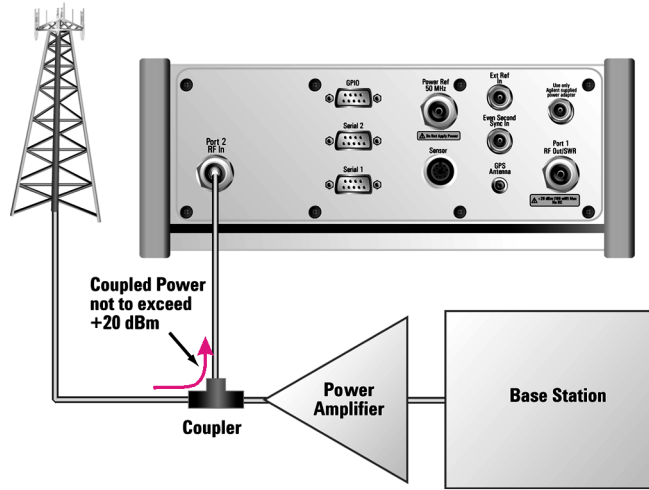
Channel Scanner Using the Channel Scanner

Step	Notes
7	Enter the number of channels. a. [Num Chans] b. Enter the number using the numeric keypad. c. [Enter]
8	Connect to the base station.

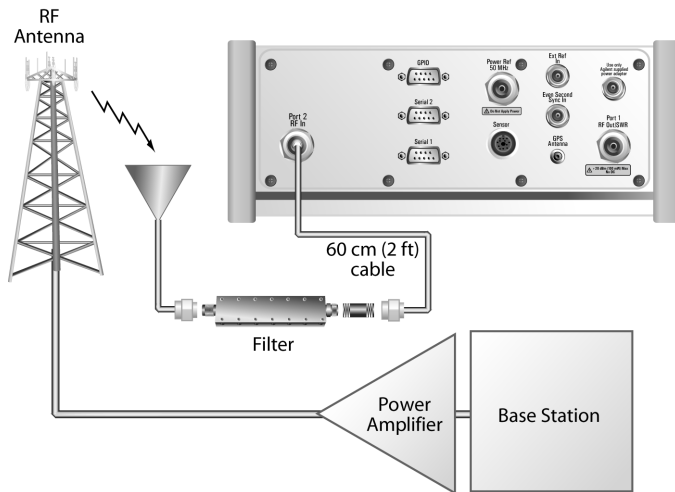


Out of service connection

Step	Notes
------	-------



In service connection



Over the air measurement connection

Channel Scanner

Using the Channel Scanner

NOTE

The *autoranging* feature under [Setup], [Range Control] that is built into the test set helps ensure accurate measurements by changing front-end amplifier gain as needed. This might be, for example, when a strong signal threatens to overload the test set. When this occurs, the noise floor rises (as gain is decreased), then falls again when the strong signal stops.

If you prefer a fixed noise floor, you can disable autoranging in two ways using the Setup function within Channel Scanner:

- On [Range Ctrl] select **Hold** to fix the noise floor at the current level. A subsequent strong signal—even outside the measurement range—may cause an inaccurate reading due to overloading the front-end of the test set.
- On [Range Ctrl] select **Max** to fix the noise floor at the current level until a strong signal comes in. In that case, the floor will rise to maintain accuracy, but will not return to its lower level after the strong signal stops.

Displaying Accurate Peak Power (Recommended for Pulsed Signals)

For pulsed signals, you can get a more accurate measurement of the signal's peak or average power by using the Peak Power Detector option in the test set.

The test set measures average power of signals by default. But for non-constant-duty-cycle signals such as GSM, an average power reading fails to accurately show amplitude when the signal is on if other timeslots in the frame are powered off.

If the [Power Detector] menu key is grayed out, the test set needs to be upgraded in order to measure pulsed signals. Contact the Agilent Service Center for upgrade information.

Step	Notes
1 [Setup]	
2 On [Power Detector] select Pk .	Each time you press this softkey, the selected option changes.

Setting the Analyzer Input Gain

Normally the E7495A/B is set to add the most gain in the receive path to boost low-level signals. If the signal is high, there is no reason to add gain. When you're measuring a strong signal, select low sensitivity to reduce the gain in the receive path and lower the noise floor. For a low level signal, select high.

Step	Notes
1 [Setup]	
2 [Sensitivity]	
3 Low or High	

NOTE

The Sensitivity setting is coupled to the Noise Correction setting. Changing the Sensitivity setting from **Low** to **High** will cause the Noise Correction setting to change from **On** to **Off**. Conversely, if the Noise Correction setting is changed from **Off** to **On**, the Sensitivity setting is changed from **High** to **Low**.

Setting Noise Correction

You can turn the Noise Correction function **On** or **Off**. When set to **On**, noise correction will be activated and correct for the noise generated internally by the analyzer. It allows the you to make accurate measurements on signals close to the noise floor.

To Set the Measurement Noise Correction:

Step	Notes
1 [Setup]	
2 On [Noise Correction] select On or Off .	Each time you press this softkey, the selected option changes.

Entering the Channels with a List Instead of a Range

Step	Notes
1 Select Channel Scanner. a. Mode b. [Spectrum Analyzer/Tools] c. [Channel Scanner]	
2 Select the channel standard. a. [CS Chan Std] b. Select the standard using the up and down arrow buttons. c. [Select]	
3 On [CS Units] select Chan .	Each time you press this softkey, the selected option changes.
4 On [Scan Mode] select List .	Each time you press this softkey, the selected option changes.
5 View or modify your list of channels. a. [List] b. [Ok]	View (and modify if necessary) your list of channels.

Step	Notes
6	Enter channels into the list.
a.	Use [Insert Row] to add a channel, then enter its number using the numeric keypad and [Fwd] or [Rev] to complete each entry.
b.	Use [Delete Row] to remove channels you do not want displayed. Select a channel you want to remove using the up and down arrow buttons. Then press [Delete Row] to remove the selected channel.
c.	[Ok]

Entering the Channel Power Measurement Bandwidth and Time

When performing a channel power measurement, you must specify a measurement bandwidth and measurement time. These parameters determine how the analyzer measures each channel on the Channel Scanner. Depending on the modulation format of signal you are trying to measure (CDMA, GSM, and so forth), different measurement bandwidths and times are required. You have three ways of selecting these parameters:

- Press [Format/BW], then on [Format Type] select **List**, and then select the format from a list—independently of the channel standard.
- Select [Format/BW], then on [Format Type] select **Cust**. Then select the measurement bandwidth and measurement time for each channel.

To Select the Channel Format Type:

Step	Notes
1	[Format/BW]

Channel Scanner

Using the Channel Scanner

Step	Notes
2 On [Format Type] select Chan .	<p>Each time you press this softkey, the selected option changes. The option you select determines which buttons on the right are active.</p> <p>Each channel standard has an associated modulation format. With this method, the optimum measurement bandwidth and measurement time for the modulation format are automatically selected when you set the channel standard. For example, when you select GSM-950 as the channel standard, with this method the test set selects the bandwidth and time for the GSM format.</p>
3 Select the standard you want.	
a. [CS Chan Std]	
b. Select the standard using the up and down arrow buttons.	
c. [Select]	

To Select the List Format Type:

Step	Notes
1 [Format/BW]	
2 On [Format Type] select List .	<p>Each time you press this softkey, the selected option changes. The option you select determines which buttons on the right are active.</p>

- | | |
|---|---|
| <ol style="list-style-type: none"> 3 Select the format you want. <ol style="list-style-type: none"> a. [Format List] b. Select the standard using the up and down arrow buttons. c. [Select] | <p>This selection is independently of the channel standard selected under [Freq/Chan], [CS Chan Std].</p> |
|---|---|

To Select the Custom Format Type:

Step	Notes
1 [Format/BW]	
2 On [Format Type] select Cust.	Each time you press this softkey, the selected option changes. Each channel standard has an associated modulation format. With this method, the optimum measurement bandwidth and measurement time for the modulation format are automatically selected when you set the channel standard. For example, when you select GSM-950 as the channel standard, with this method the test set selects the bandwidth and time for the GSM format.
4 Set the channel power measurement bandwidth and measurement time. <ol style="list-style-type: none"> a. [Meas BW] b. Enter the bandwidth on the numeric keypad. c. [GHz] or [MHz] or [kHz] or [Hz] d. [Meas Time] e. Enter the time on the numeric keypad. f. [ms] 	

Setting Average, Sweep, and Restart

Setting the Sweep

You can select either continuous or single sweep. Continuous sweep provides repeated, ongoing measurements. Single sweep performs a single measurement that is repeated only when you push the Single button.

To set sweep:

Step	Notes
1 [Average/Sweep]	
2 [Continuous] or [Single]	Each time you press this softkey, the selected option changes.

Setting Averaging

You can choose to have averaging **On** or **Off** and set the number of averages you want to take. Averaging only applies to the data, not the trace. You can select from the following types of averaging:

- **Off:** Disables averaging.
- **Running:** Computes the new result as the weighted sum of the last result and the new measurement. The last result is weighted by $(n - 1)/n$. The new result is weighted by $1/n$. Each new measurement produces a new result.
- **Max Hold:** Is not an average, but on a point by point basis, displays the maximum amplitude for the given frequency or channel since Max Hold was turned on. It is updated when a new maximum occurs.
- **Group Average:** Makes the requested number of measurements, averages the measurement data, and displays the average as a single result trace. Measurement time will vary based on the requested number of averages and can take minutes for very large number of averages.
- **Group Max Average:** Makes the requested number of measurements before returning a single trace result. This trace is the maximum value seen at each trace point over the requested number of averages (measurements).

To set averaging:

Step	Notes
1	Set the number of averages. <ol style="list-style-type: none"> a. [Average] b. Enter the number of averages using the numeric keypad. c. [Enter]
2	Select the type of averaging you want to apply. <ol style="list-style-type: none"> a. [Average/Sweep] b. [Averaging] c. [Off], [Running Average], [Max Hold], [Group Average], or [Group Max Average]

NOTE

These two steps can be performed in any order. However, if you turn averaging **On** and a large number of averages has previously been set, there may be a delay before you can change number of averages.

Setting Restart

When you have averaging turned **On** and you are in **Continuous** Sweep mode, you can restart the averaging by pressing the Restart menu key. The Restart key has no effect if you are in **Single** sweep mode.

To restart averaging:

Step	Notes
1	[Average/Sweep]
2	[Restart] <p>This key is unavailable or has no effect when Sweep is set to Single. To restart a Single Sweep measurement, press [Single].</p>

Displaying Frequency or Power

You can display frequency or power values above the bars in the trace display. The displayed frequency is the average instantaneous frequency when the signal is active.

For CDMA type signals, the frequency option is not recommended; accurate frequencies for CDMA are not displayed.

Step	Notes
1 [Setup]	
2 On [Display Value] select Off , Freq , or Pwr .	Each time you press this softkey, the selected option changes. Choosing Off displays no values above the bars.

Setting the Pass/Fail Limits

The measurement limits setting enables you to alter the value of the upper and lower test limits. The settings you choose define the location of the limit lines displayed on the screen. These settings affect the color of the bar graph display and the measured value: red represents fail, green represents pass, and blue indicates that the limits are turned off.

- **Power Limits:** Sets the high and low limits of the channel power. Limits are set in dB and are relative. Any channel value that is outside of the set limits will result in a failure indication.
- **Frequency Limits:** Sets the high and low frequency limits for each channel. Limits are set in Hz. These settings affect the display color as indicated above, but there are no limit lines shown on the display.

To Set the Measurement Upper and Lower Limits:

Step	Notes
1 [Setup]	
2 [Limits]	
3 [Power Limits]	

Step	Notes
<p>3 On [Power Limits] select On or Off.</p>	<p>Enables you to toggle the measurement limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> • If set to On, upper and lower limit lines are displayed on the screen. Any measured channel value that exceeds the upper limit or is less than the lower limit will result in a failure indication for that value. • If set to Off, the channel power value will be displayed in blue. The bar graph will be blue if neither Power or Frequency Error Limit has been set to On. <p>Note: the screen will only display values and pass/fail indications for one set of limits at a time. If you have Frequency limits turned on then choose to turn on Power limits, the Frequency limits will turn off.</p>
<p>4 Set the upper limit.</p> <p style="margin-left: 20px;">a. [Power High Limit]</p> <p style="margin-left: 20px;">b. Enter the number on the numeric keypad.</p> <p style="margin-left: 20px;">c. [dB]</p>	<p>Maximum Upper limit: top of display</p>
<p>5 Set the lower limit.</p> <p style="margin-left: 20px;">a. [Power Low Limit]</p> <p style="margin-left: 20px;">b. Enter the number on the numeric keypad.</p> <p style="margin-left: 20px;">c. [dB]</p>	<p>Maximum Lower Limit: bottom of display</p>

Channel Scanner

Using the Channel Scanner

Step	Notes
6	<p>On [Freq Error Limits] select On or Off.</p> <p>Enables you to toggle the measurement limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none">• If set to On, the displayed channel frequency and the bar graph will change from blue to red (fail) or green (pass). Any measured value that exceeds the upper limit or is less than the lower limit will result in a failure indication for that value.• If set to Off, the channel freq/number value will be displayed in blue. The bar graph will be blue if neither Power or Frequency Error Limit has been set to On <p>Note: the screen will only display values and pass/fail indications for one set of limits at a time. If you have Power limits turned on then choose to turn on Frequency limits, the Power limits will turn off.</p>
4	<p>Set the upper limit.</p> <p>a. [Frequency High Limit]</p> <p>b. Enter the number on the numeric keypad.</p> <p>c. [GHz], [MHz], [kHz], or [Hz]</p> <p>Maximum Upper limit: 1 GHz</p> <p>Minimum Upper limit: 0.0 GHz</p>
5	<p>Set the lower limit.</p> <p>a. [Frequency Low Limit]</p> <p>b. Enter the number on the numeric keypad.</p> <p>c. [GHz], [MHz], [kHz], or [Hz]</p> <p>Maximum Lower limit: 0.0 Hz</p> <p>Minimum Lower limit: -1 GHz</p>

8

Adjacent Channel Power

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- “Making a Basic Adjacent Channel Power Measurement” on page 181
- “Setting the Adjacent Channel Power Format” on page 183
- “Setting Average, Sweep, and Restart” on page 187
- “Displaying Accurate Peak Power (Recommended for Pulsed Signals)” on page 189
- “Setting the Control Units” on page 189
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- “Setting Noise Correction” on page 191
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- “Setting Up the Signal Generator” on page 194
- “W-CDMA (UMTS) Adjacent Channel Leakage Power Ratio (ACLR) Measurements” on page 197

Adjacent Channel Power

Using the Adjacent Channel Power Measurement

Using the Adjacent Channel Power Measurement

Adjacent Channel Power measures the power of the carrier and the power of the noise in its adjacent channels. The measurement results can help you determine whether the power is set correctly and whether the transmitter filter is working properly. Once you have set the limits, you can easily see whether a test falls within those limits using the mask feature and the color-coded metrics. You can measure the adjacent channel power on one to three adjacent channels on each side of your center channel in the CDMA, UMTS, TDMA, GSM Edge and GPRS, AMPS, NMT-450, Tetra, and iDEN channel bands.

CAUTION

When measuring multiple adjacent channels, the combined channel power must not exceed +20 dBm at the RF In port.

CAUTION

The maximum power for the RF In and RF Out/SWR port is 20 dBm (100 mW). The maximum power for the Power Sensor port is 24 dBm (300 mW). When directly coupled to a base station, the test set can be damaged by excessive power applied to any of these three ports.

To prevent damage in most situations when you directly couple the test set to a base station, use the high power attenuator between the test set and the BTS.

NOTE

For complex modulation such as CDMA, W-CDMA, 1xEV-DO and GSM, the frequency error measurement is not accurate (see respective analyzers for detailed frequency error results).

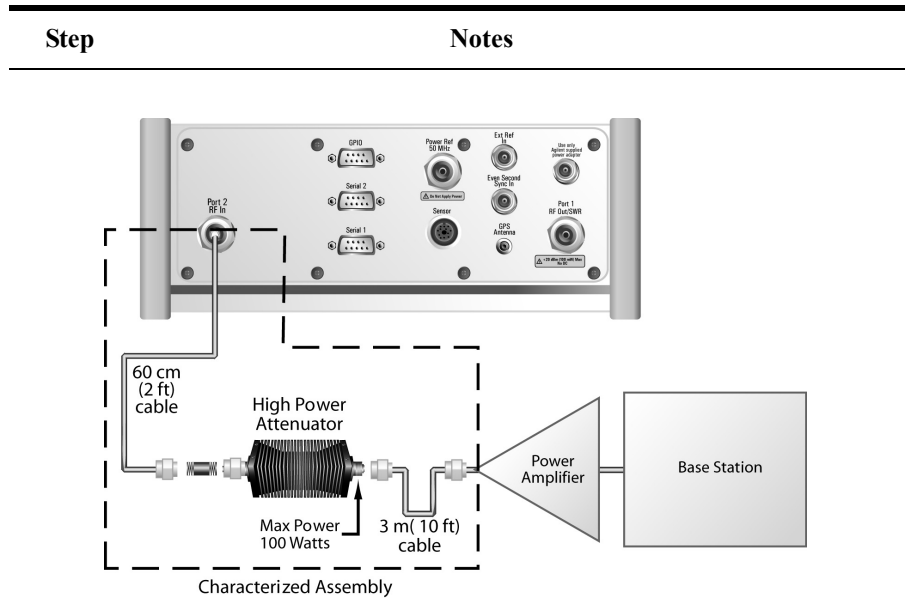
NOTE

The RF in loss can be added manually or automatically by performing an insertion loss measurement. For measurement instructions refer to [“Performing \(and Calibrating\) a Basic One Port Insertion Loss measurement”](#) on page 75 or [“Normalizing and Performing a Basic Two Port Insertion Loss Measurement”](#) on page 57.

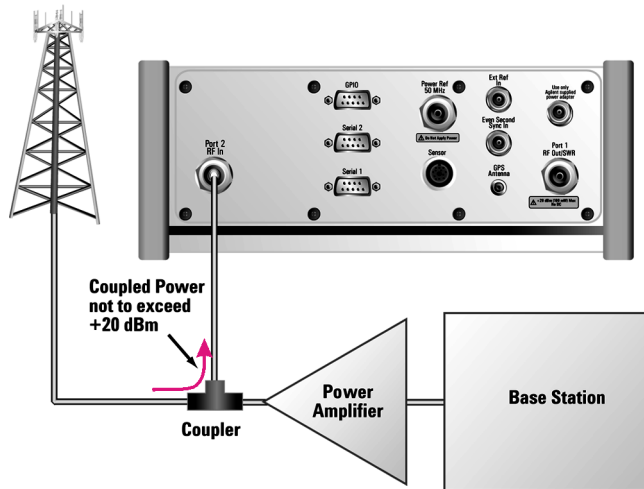
Making a Basic Adjacent Channel Power Measurement

Step	Notes
1. Select Adjacent Channel Power. <ol style="list-style-type: none"> a. Mode b. [Spectrum Analyzer/Tools] c. [Adjacent Channel Power] 	
2. Select the channel standard. <ol style="list-style-type: none"> a. [Chan Std] b. Select the standard using the up and down arrow buttons. c. [Select] 	
3. On [Units] select Chan .	Each time you press this softkey, the selected option changes. (The instructions in this manual show selections for Channel.)
4. Setup the frequency/channel you want to view. <ol style="list-style-type: none"> a. [Freq/Chan] b. [Channel] c. Enter the number on the numeric keypad. d. [Fwd] or [Rev] 	
5. Connect to the base station.	
6. Set the level/location. <ol style="list-style-type: none"> a. [Level/Location] b. [Autoscale] c. [Select] 	If the adjacent channel power trace is not visible, you can change the reference level or use Autoscale to have the test set select a reference level for you.

Adjacent Channel Power Using the Adjacent Channel Power Measurement



Out-of-service connection



In-service connection (valid for center channel; adjacent channel measurements may not be valid because there may be active adjacent channels.)

Setting the Adjacent Channel Power Format

When performing an adjacent channel power measurement, several measurement settings must be specified. The measurement settings include bandwidth and measurement time for the center channel. In addition, the measurement settings for the adjacent channels are:

- number of adjacent channels
- offset of the first adjacent channel from the center channel
- offset of the adjacent channels from each other
- measurement bandwidth and measurement time for each adjacent channel

These settings determine how the DSP measures the center channel and its adjacent channels. Depending on the modulation type of the signal you are trying to measure (CDMA, GSM, and so forth), different measurement bandwidths, times, and offsets are required.

Default adjacent channel power measurement settings, called ACP formats, are provided in the E7495A/B base station test sets. Generally, the ACP format is determined by the channel standard you select. However, to accommodate your particular situation, you can decouple the default formats from the channel standard, or you can change each measurement setting independently. The three methods of selecting your measurement settings are:

- **Channel:** Each channel standard has an associated ACP format. With this method, the optimum measurement bandwidth and measurement time for the modulation type are automatically selected when you set the channel standard. For example, when you select GSM-950 as the channel standard, with this method the test set selects the bandwidth and time and adjacent channel offsets for the GSM format.
- **List:** Select the ACP format from a list of values that are set automatically—independent of the channel standard.
- **Custom:** Manually set all parameters: the measurement bandwidth and measurement time for the center and adjacent channel(s), the offset from the center channel for the first adjacent channel, and the offset between adjacent channels.

Adjacent Channel Power

Using the Adjacent Channel Power Measurement

To Select the Channel Format Type:

Step	Notes
1 [ACP Format]	
2 [Format Type]	Each time you press this softkey, the selected option changes. The option you select determines which buttons on the right are active.
3 [Chan]	
4 Select the standard you want. <ul style="list-style-type: none"> a. [Chan Std] b. Select the standard using the up and down arrow buttons. c. [Select] 	Channel BW/Time is available, but all buttons are grayed out, enabling you only to view the settings. To change any of the settings, choose Cust.

To Select the List Format Type:

Step	Notes
1 [ACP Format]	
2 [Format Type]	Each time you press this softkey, the selected option changes. The option you select determines which buttons on the right are active.
3 [List]	
4 Select the format you want. <ul style="list-style-type: none"> a. [Format List] b. Select the standard using the up and down arrow buttons. c. [Select] 	Channel BW/Time is available, but all buttons are grayed out, enabling you only to view the settings. To change any of the settings, choose Cust.

To Select the Custom Format Type:

Step	Notes
1 [ACP Format]	
2 [Format Type]	Each time you press this softkey, the selected option changes. The option you select determines which buttons on the right are active.
3 [Cust]	
4 Set the carrier and adjacent channel bandwidth.	
a. [Channel BW/Time]	
b. [Center Chan Meas BW]	
c. Enter the center channel bandwidth on the numeric keypad.	
d. [GHz] or [MHz] or [kHz] or [Hz]	
e. [Center Chan Meas Time]	
f. Enter the center channel measurement time on the numeric keypad.	
g. [ms]	
h. [Adj Chan Meas BW]	
i. Enter the adjacent channel bandwidth on the keypad.	
j. [GHz] or [MHz] or [kHz] or [Hz]	
k. [Adj Chan Meas Time]	
l. Enter the adjacent channel measurement time on the keypad.	
m. [ms]	

Adjacent Channel Power

Using the Adjacent Channel Power Measurement

-
- | | | |
|---|---|--|
| 5 | Enable the frequency error function from the BW/Time menu.

a. On [Freq Err] select On . Each time you press this softkey, the Frequency Error state (On or Off) changes.

b. [Back] | When Frequency Error is switched On, the Frequency Error result is added to the metrics display at the bottom of the screen. |
|---|---|--|
-
- | | | |
|---|---|--|
| 6 | Set the offset from the carrier to the first adjacent channel.

a. [Ctr to Adj Step Size]

b. Enter the offset on the numeric keypad.

c. [GHz] or [MHz] or [kHz] or [Hz] | |
|---|---|--|
-
- | | | |
|---|--|--|
| 7 | Set the offset between adjacent channels.

a. [Adj to Adj Step Size]

b. Enter the offset on the numeric keypad.

c. [GHz] or [MHz] or [kHz] or [Hz] | |
|---|--|--|
-
- | | | |
|---|---|--|
| 8 | Set the number of adjacent channels (from 0-3).

a. Enter the number on the numeric keypad.

b. [Enter] | |
|---|---|--|
-

Setting Average, Sweep, and Restart

Setting the Sweep

You can select either continuous or single sweep. Continuous sweep provides repeated, ongoing measurements. Single sweep performs a single measurement that is repeated only when you push the Single button.

To set sweep:

Step	Notes
1 [Average/Sweep]	
2 [Continuous] or [Single]	Each time you press this softkey, the selected option changes.

Setting Averaging

You can choose to have averaging on or off and set the number of averages you want to take. Averaging only applies to the data, not the trace. You can select from the following types of averaging:

- **Off:** Disables averaging.
- **Running:** Computes the new result as the weighted sum of the last result and the new measurement. The last result is weighted by $(n - 1)/n$. The new result is weighted by $1/n$. Each new measurement produces a new result.
- **Max Hold:** Is not an average, but on a point by point basis, displays the maximum amplitude for the given frequency or channel since Max Hold was turned on. It is updated when a new maximum occurs.
- **Group Average:** Makes the requested number of measurements, averages the measurement data, and displays the average as a single result trace. Measurement time will vary based on the requested number of averages and can take minutes for very large number of averages.
- **Group Max Average:** Makes the requested number of measurements before returning a single trace result. This trace is the maximum value seen at each trace point over the requested number of averages (measurements).

Adjacent Channel Power

Using the Adjacent Channel Power Measurement

To set averaging:

Step	Notes
1	Set the number of averages. <ol style="list-style-type: none"> [Average] Enter the number of averages using the numeric keypad. [Enter]
2	Select the type of averaging you want to apply. <ol style="list-style-type: none"> [Average/Sweep] [Averaging] [Off], [Running Average], [Max Hold], [Group Average], or [Group Max Average]

NOTE

These two steps can be performed in any order. However, if you turn averaging on and a large number of averages has previously been set, there may be a delay before you can change number of averages.

Setting Restart

When you have averaging turned **On** and you are in **Continuous** Sweep mode, you can restart the averaging by pressing the Restart menu key. The Restart key has no effect if you are in **Single** sweep mode.

To restart averaging:

Step	Notes
1	[Average/Sweep]
2	[Restart] <p>This key is unavailable or has no effect when Sweep is set to Single. To restart a Single Sweep measurement, press [Single].</p>

Displaying Accurate Peak Power (Recommended for Pulsed Signals)

For pulsed signals, you can get a more accurate measurement of the signal's peak or average power by using the Peak Power Detector option in the test set.

The test set measures average power of signals by default. But for non-constant-duty-cycle signals such as GSM, an average power reading fails to accurately show amplitude when the signal is **On** if other timeslots in the frame are powered **Off**.

If the [Power Detector] menu key is grayed out, the test set needs to be upgraded in order to measure pulsed signals. Contact the Agilent Service Center for upgrade information.

If it is not a peak signal, it is probably better to select **Average** for a more accurate result.

To Display Peak Power:

Step	Notes
1 [Setup]	
2 On [Power Detector] select Pk .	Each time you press this softkey, the selected option changes.

Setting the Control Units

In some instances you may be provided specifications by engineering in either dBm or watts. You can switch between the two units in order to make it easier to interpret measurement results.

To Change Units on the Y-Axis:

Step	Notes
1 [Level/Location]	
2 [Units]	Each time you press this softkey, the selected option changes.

Adjacent Channel Power

Using the Adjacent Channel Power Measurement

Step	Notes
3 [dBm] or [Watts]	There is no change made to the Y-axis. The change is to the units for entry. The reference level changes on the graph, but not the axis labels.

Setting the Range Control

The autoranging feature, which is built into the test set, helps ensure accurate measurements by changing front-end amplifier gain as needed, for example, when a strong signal threatens to overload the test set. When this occurs, the noise floor rises (as gain is decreased), then falls again when the strong signal stops. To select this feature:

- On [Range Ctrl] select **Auto** to enable the E7495A/B to continuously adjust the noise floor to the optimum setting.

If you prefer a fixed noise floor, you can disable autoranging in two ways using the Setup function within Spectrum Analyzer:

- On [Range Ctrl] select **Hold** to fix the noise floor at the current level. A subsequent strong signal—even outside the measurement range—may cause an inaccurate reading due to overloading the front-end of the test set.
- On [Range Ctrl] select **Max** to fix the noise floor at the current level until a strong signal comes in. In that case, the floor will rise to maintain accuracy, but will not return to its lower level after the strong signal stops.

Step	Notes
1 [Setup]	
2 [Range Ctrl]	
3 [Auto] [Hold] or [Max]	

Setting the Analyzer Input Gain

Normally the E7495A/B is set to add the most gain in the receive path to boost

Adjacent Channel Power Using the Adjacent Channel Power Measurement

low-level signals. If the signal is high, there is no reason to add gain. When you're measuring a strong signal, select **Low** sensitivity to reduce the gain in the receive path and lower the noise floor. For a low level signal, select **High**.

Step	Notes
1 [Setup]	
2 [Sensitivity]	
3 Low or High	

NOTE

The Sensitivity setting is coupled to the Noise Correction setting. Changing the Sensitivity setting from **Low** to **High** will cause the Noise Correction setting to change from **On** to **Off**. Conversely, if the Noise Correction setting is changed from **Off** to **On**, the Sensitivity setting is changed from **High** to **Low**.

Setting Noise Correction

You can turn the Noise Correction function on or off. When set to On, noise correction will be activated and the test set will correct for the noise generated internally by the analyzer. It allows the you to make accurate measurements on signals close to the noise floor.

To Set the Measurement Noise Correction:

Step	Notes
1 [Setup]	
2 On [Noise Correction] select On or Off .	Each time you press this softkey, the selected option changes.

Setting the Pass/Fail Limits

The E7495A/B uses generic defaults, rather than standard defaults. You can change those to accommodate your base station settings.

- **Power Limits:** Sets the high and low limits of the center channel, as well as the

Adjacent Channel Power

Using the Adjacent Channel Power Measurement

high limit of the adjacent channels. Center channel limits are set in dBm and are absolute. Adjacent channel limits are set in dB and are relative to the center channel power. The settings you choose define the shape of the mask displayed on the screen. To measure only the outer frequencies, turn off the mask. These settings affect the metrics color display: red represents fail, green represents pass.

- **Frequency Limits:** Sets the high and low frequency limits for the center channel only. These settings affect the metrics color display: red represents fail, green represents pass.

To Change Power Limits:

Step	Notes
1 [Setup]	
2 [Limits]	
3 [Power Limits]	
4 [On] or [Off]	
5 Set the center channel upper limit.	
a. [Center Chan High Limit]	
b. Enter the number on the numeric keypad.	
c. [dBm]	
6 Set the center channel lower limit.	
a. [Center Chan Low Limit]	
b. Enter the number on the numeric keypad.	
c. [dBm]	

Step	Notes
7 Set the adjacent channel 1 upper limit. a. [Adj Chan 1 High Limit] b. Enter the number on the numeric keypad. c. [dB]	
8 Set the adjacent channel 2 upper limit. a. [Adj Chan 2 High Limit] b. Enter the number on the numeric keypad. c. [dB]	
9 [Back]	

Adjacent Channel Power

Using the Adjacent Channel Power Measurement

To Change Frequency Limits:

Step	Notes
1 [Setup]	
2 [Frequency Limits]	
3 [On] or [Off]	
4 Set the upper limit.	
a. [Frequency High Limit]	
b. Enter the number on the numeric keypad.	
c. [GHz] or [MHz] or [kHz] or [Hz]	
5 Set the lower limit.	
a. [Frequency Low Limit]	
b. Enter the number on the numeric keypad.	
c. [GHz] or [MHz] or [kHz] or [Hz]	

Setting Up the Signal Generator

You can set up the signal generator while in the Spectrum Analyzer mode from the Setup menu. For more detailed information on the signal generator setup and operation, refer to [“Using the Signal Generator” on page 200](#)

CAUTION

The maximum power for the RF In and RF Out/SWR port is 20 dBm (100 mW). The maximum power for the Power Sensor port is 24 dBm (300 mW). When directly coupled to a base station, the test set can be damaged by excessive power applied to any of these three ports.

To prevent damage in most situations when you directly couple the test set to a base

station, use the high power attenuator between the test set and the BTS.

NOTE

The lowest level the signal generator can go to is -90 dBm. In order to get a lower level, you must use an external attenuator. You can compensate for the attenuator using RF Out Loss.

Step	Notes
1 [Setup]	
2 [Sig Gen]	
3 [Freq/Chan]	
4 Enter the channel or frequency using the numeric keypad.	
5 <ul style="list-style-type: none"> • For channel select [Rev] or [Fwd] • For frequency select [GHz], [MHz], [kHz], or [Hz], 	
6 [Mod Format]	
7 Select the channel standard from the list using the up and down arrow buttons.	
8 [Select]	
9 Set the RF output amplitude <ul style="list-style-type: none"> a. [Amplitude] b. Enter the amplitude value using the numeric keypad. c. [dBm]. 	You may also enter a new value for amplitude by turning the rotary knob until the desired value is displayed or using the up and down arrow keys.

Adjacent Channel Power

Using the Adjacent Channel Power Measurement

Step	Notes
10	<p>If you have previously stored RF Out Loss from an insertion loss measurement, go to the next step.</p> <p>Or</p> <p>Press [RF OUT Loss] to select On and enter the RF Out Loss value.</p>
11	<p>Connect to the base station.</p>
12	<p>On [Enable Sig Gen] select On.</p>

Using the RF OUT Loss field

The RF OUT Loss field is used when it is necessary to test the receiver sensitivity of a typical base station. The test set's source will typically go down to -90 dBm, in order to reach -113 dBm for sensitivity testing, you must use an external pad. The measured value of the pad and connecting cables are entered into this field. This value is then used when this field is set to **On**. When this field is set to **On**, the test set will set the RF generator level to the correct level offset by the external pad/cabling. When you set the RF Generator to -113 dBm (with the RF OUT Loss field turned **On** and the external pad/cabling loss value entered) the output at the end of the RF test cabling is -113 dBm.

Example: If you want to set the signal generator to -113 dBm, the pad and RF cabling measures 42.51 dB (measured with the 2 port insertion loss measurement screen prior to this test), the RF OUT Loss field is turned **On** (with the 42.51 dB loss value entered). The actual RF output of the signal generator is -70.49 dBm, the pad and RF cabling attenuated the signal to the desired level; so the RF signal at the end of the test cable/pad is -113 dBm. This also points out the importance of accurately measuring the loss of the pad and connecting cables.

W-CDMA (UMTS) Adjacent Channel Leakage Power Ratio (ACLR) Measurements

One of the most important measurements on RF signals for digital communication systems is the leakage power into the adjacent channels. A quantitative figure of merit is adjacent channel power ratio (ACPR) or adjacent channel leakage ratio (ACLR). The ACLR measurement determines how much of the transmitted power is allowed to leak into the first and second neighboring carriers (high side and low side). Leakage of RF power into adjacent channels or bands can cause major interference to occur on another carrier's network.

The measurement of ACLR is defined as the ratio of the average power in the adjacent frequency channel to the average power in the transmitted frequency channel. It is reported in dBc (dB relative to the main carrier).

Test models are used to have pre-defined test conditions for base station conformance test of ACLR. Under 3GPP TS 25.141, five types of test models are defined. Each test model consists of PCCPCH (Primary Common Control Physical Channel), PICH (Paging Indication Channel), CPICH (Common Pilot Channel), SCH (Synchronization Channel) and some DPCHs (Dedicated Physical Channels).

Adjacent Channel Power

W-CDMA (UMTS) Adjacent Channel Leakage Power Ratio (ACLR) Measurements

Figure 8-1

Sample Measurement of ACLR on a Valid 3GPP W-CDMA UMTS Signal

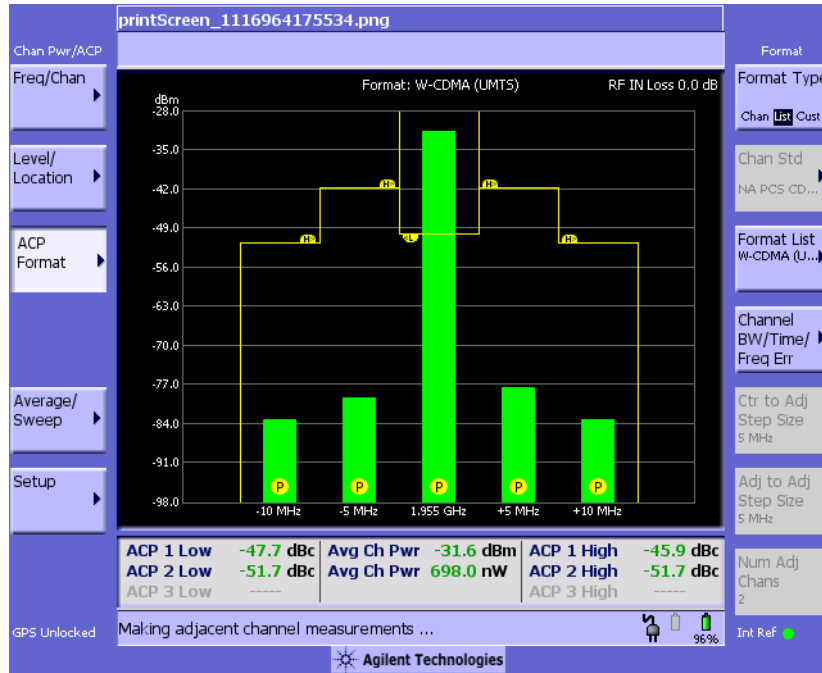


Figure 8-1 is an example of the measurement results as a bar graph of the power levels at different offsets. This gives you a quick reading of respective powers. The bar graph is green with 'P' on the bar graph, indicating the ACLR measurement passes at the 5 MHz and 10 MHz offsets.

NOTE

The 3GPP TS 25.141 standard for W-CDMA (UMTS) requires the adjacent channel power leakage ratio to be better than 45 dB at 5 MHz offset and 50 dB at 10 MHz offset.

[“Using the Signal Generator” on page 200](#)

[“Performing a Basic Signal Generator Measurement” on page 201](#)

[“Minimum and Maximum Power levels for Generated Signals” on page 200](#)

[“Persistent Signal Generator” on page 207](#)

NOTE

The information here applies to the use of the signal generator when accessed from the Spectrum Analyzer/Tools menu. For information on the use of the [Sig Gen] menu under a measurement [Setup] key menu, refer to the specific measurement chapter or measurement help topic.

Using the Signal Generator

The Signal Generator is used to check the performance of base station receivers. It supports both Received Signal Strength Indicator (**RSSI**) and CDMA Frame Error Rate (**FER**) measurements. The Signal Generator provides multiple forward and reverse-link modulation types. For a complete list of supported modulation types, press the [Modulation] menu key after you begin the measurement.

CAUTION

The maximum power for the RF In (Port 1) and RF Out/SWR (Port 2) ports is +20 dBm (100 mW). The maximum power for the Power Sensor port is +24 dBm (300 mW). When directly coupled to a base station (BTS) or Access Network (AN), the test set can be damaged by excessive power applied to any of these three ports.

To prevent damage in most situations when you directly couple the test set to a base station, use the high power attenuator between the test set and the BTS.

NOTE

The lowest power level the signal generator can go to is -90 dBm. In order to get a lower level, you must use an external attenuator. You can compensate for the attenuator using RF Out Loss.

NOTE

It usually takes around 5 to 10 seconds for your chosen signal to start being generated. A 1xEV-DO signal can take up to 30 seconds to start being generated.

Minimum and Maximum Power levels for Generated Signals

Signal	E7495A		E7495B	
	Max. Power	Min. Power	Max. Power	Min. Power
CW	-23 dBm	-90 dBm	-23 dBm	-90 dBm
CDMA Forward Link Pilot Only No Filter	-47 dBm	-95 dBm	-28 dBm	-95 dBm

	E7495A		E7495B	
Signal	Max. Power	Min. Power	Max. Power	Min. Power
CDMA Forward Link Pilot Only Filtered	-47 dBm	-95 dBm	-28 dBm	-95 dBm
CDMA IS-95 Rev Link Zero Data Traffic	-47 dBm	-95 dBm	-28 dBm	-95 dBm
CDMA IS-95 Rev Link Zero Data Access	-47 dBm	-95 dBm	-28 dBm	-95 dBm
CDMA IS-95 Rev Link Random Data Traffic	-47 dBm	-95 dBm	-28 dBm	-95 dBm
R-FCH RC3 Zero Data Fundamental	-47 dBm	-95 dBm	-28 dBm	-95 dBm
R-FCH RC3 Random Data Fundamental	-47 dBm	-95 dBm	-28 dBm	-95 dBm
1xEV-DO Rev Link	-48.5 dBm	-96.5 dBm	-29.5 dBm	-96.5 dBm

Performing a Basic Signal Generator Measurement

Step	Notes
1	Mode
2	[Spectrum Analyzer/Tools]
3	[Signal Generator]
4	[Chan Std]
5	Select the channel standard from the list using the up and down arrow buttons.
6	[Select]

Signal Generator

Using the Signal Generator

Step	Notes
7 On [Units] select Chan .	Each time you press this softkey, the analyzer switches between Channel (Chan) and Frequency (Freq). The Units settings are coupled across multiple tools.
8 [Fr/Time Ref]	Complex signals such as cdma and 1xEV-DO require accurate time and frequency references before they can be reliably generated or demodulated.
9 [GPS] or [External Even Sec]	<p>Only GPS and External Even Second provide the timing information necessary to generate an accurately modulated signal. Select GPS if you are receiving GPS location information (System, [Fr/Time Ref Location], [Show GPS Location] set to On). Otherwise, select External Even Second, and connect your external even second reference signal to the Even Second Sync In port on your test set.</p> <p>If you are not needing an accurately modulated signal (for example, you are simply generating a carrier wave), you do not need to use either GPS or External Even Second Clock as your time reference.</p>
10 [Select]	
11 [Channel]	
12 Enter the channel number using the numeric keypad.	When the channel is set, it is set across all the test set tools, so as you switch between tools, the channel is preset.
13 [Rev]	Always choose the reverse channel when performing a signal generator measurement.

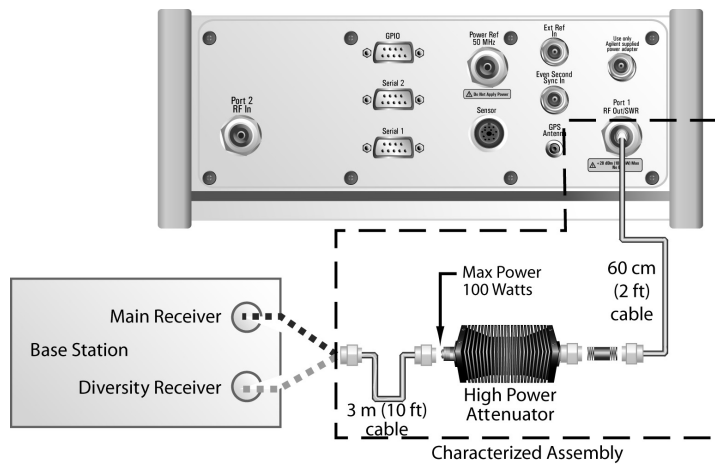
Step	Notes
14 [Modulation] If the key is grayed out, go to the step 16. Or If the key is active, go to the next step.	If the [Modulation] menu key is grayed out, your test set does not include the complex modulation option. You have only CW.
15 [Format]	You will now see a list of all the available signal formats: <ul style="list-style-type: none">• CW (No modulation) - an unmodulated carrier wave• CDMA Forward Link (Pilot only) without Equalization Filter• CDMA Forward Link (Pilot only) with Equalization Filter• CDMA IS-95 Reverse Link - Zero Data Traffic Channel• CDMA IS-95 Reverse Link - Zero Data Access Channel• CDMA IS-95 Reverse Link - Random Data Traffic Channel• R-FCH RC3 Zero Data Fundamental Channel• R-FCH RC3 Random Data Fundamental Channel• 1xEV-DO Reverse Link 9.6 kB 15PN data (ARB) - parameters such as PN Offset are fixed in this file and cannot be altered. Be aware that it can take up to 30 seconds for a 1xEV-Do signal to start being generated.^a

Signal Generator

Using the Signal Generator

Step	Notes
16	<p>Select the signal format from the list using the up and down arrow keys.</p> <p>a. If you have selected a CDMA Forward Link modulation type, select PN Offset. For other modulation types, you do not need to select PN Offset.</p> <p>b. If you have selected cdma2000 modulation with fundamental channels, you also need to press [R-FCH Pwr].</p>
17	<p>Enable the RF output, set the RF output amplitude, and set the step key increments.</p> <p>a. [RF] Select On.</p> <p>b. [Amplitude]</p> <p>c. [Amplitude]</p> <p>d. Enter the amplitude value using the numeric keypad.</p> <p>e. [dBm]</p> <p>f. [Ampl Step]</p> <p>g. Enter the step value using the numeric keypad.</p> <p>h. [dB]</p>

Step	Notes
18	<p>If you have previously stored RF Out Loss from an insertion loss measurement, go to the next step.</p> <p>Or</p> <p>Press [RF OUT Loss] to select On and enter the RF Out Loss value.</p>
19	Connect to the base station.



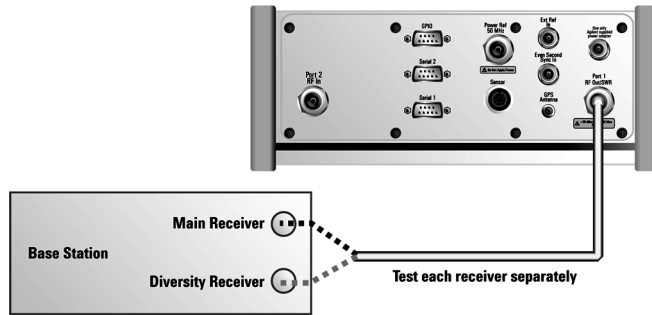
Low level non duplex connection

Signal Generator

Signal Generator

Using the Signal Generator

Step	Notes
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High level non duplex connection

20 On [RF] select **On**. Each time you press this softkey, the selected option changes.

a. The characteristics of any 1xEV-DO signal generated are:

RRI Active: RRI Bits: 1
DRC Channel Relative Gain: +3 dB
ACK Channel relative Gain: 0 dB
Data Channel Relative Gain: +3.75 dB
Data Channel: Active
Data Channel Data Rate: 9.6 kbps
Data Channel bit stream: PN15
I Mask: 3FF8000000
Q Mask: 3FF0000001
Filter Type: IS 95 Std

Using the RF OUT Loss field

The RF OUT Loss field is used when it is necessary to test the receiver sensitivity of a typical base station. The test set's source will typically go down to -95 dBm, in order to reach -113 dBm for sensitivity testing, you must use an external pad. The measured value of the pad and connecting cables are entered into this field. This value is then used when this field is set to **On**. When this field is set to **On**, the test set will set the RF generator level to the correct level offset by the external pad/cabling. When you set the RF Generator to -113 dBm (with the RF OUT Loss field turned **On** and the external pad/cabling loss value entered) the output at the end

of the RF test cabling is -113 dBm.

Example: If you want to set the signal generator to -113 dBm, the pad and RF cabling measures 42.51 dB (measured with the 2 port insertion loss measurement screen prior to this test), the RF OUT Loss field is turned **On** (with the 42.51 dB loss value entered). The actual RF output of the signal generator is -70.49 dBm, the pad and RF cabling attenuated the signal to the desired level; so the RF signal at the end of the test cable/pad is -113 dBm. This also points out the importance of accurately measuring the loss of the pad and connecting cables.

Persistent Signal Generator

The signal generator function can be used simultaneously with other measurement functions of the test set. This allows you to use the test set as both the source and the measurement device when making your measurements. To do this, setup the signal generator as described in [“Performing a Basic Signal Generator Measurement” on page 201](#). Then proceed as described below.

Step	Notes
1	Mode
2	[Spectrum Analyzer/Tools]
3	[Signal Generator]
4	[Freq/Chan/Time Ref]
5	On [Persist Sig Gen] select Yes . Each time you press this softkey, the selected option changes. Yes turns the persistent signal generator function On and No turns the function Off . When the persistent signal generator is turned On , an icon (☺) appears in the lower-right corner of the display.
6	Mode
7	Select the desired measurement mode and proceed with your measurements

Signal Generator

Using the Signal Generator

Step	Notes
17 [Amplitude]	Changes the RF output power. Amplitude becomes the active function and the current value is shown in the active entry area of the display. To enter a new value for amplitude, turn the rotary knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad. Then press [dBm].

[“Making an Average Power Measurement” on page 210](#)

[“Making a Basic Average Power Measurement” on page 211](#)

[“Setting Power Meter Resolution” on page 214](#)

[“Setting the Power Meter’s High and Low End-Points” on page 215](#)

[“Setting the Power Meter’s Upper and Lower Limits” on page 216](#)

Making an Average Power Measurement

Average power measurements provide a key metric in transmitter performance. Transmit power must be set accurately to achieve optimal coverage in wireless networks. If transmit power is set too high due to inaccurate power measurements, undesired interference can occur. If transmit power is set too low, coverage gaps or holes may occur. Either case affects system capacity and translates into decreased revenue for service providers.

Average power can be measured while the base station is active for the channel of interest. All other channels should be inactive. Average power is a broadband measurement, so if there are other signals present it will also measure their power contributions.

NOTE The test set supports the Agilent 8482A and 8481A power sensors.

CAUTION The maximum power for the RF In and RF Out/SWR port is 20 dBm (100 mW). The maximum power for the Power Sensor port is 24 dBm (300 mW). When directly coupled to a base station, the test set can be damaged by excessive power applied to any of these three ports.

To prevent damage in most situations when you directly couple the test set to a base station, use the high power attenuator between the test set and the BTS.

NOTE If you suspect other signals may be present, it is recommended that you turn off all the other channels and measure average power on the signal of interest alone. Another option is to measure channel power (which is inherently less accurate), but filters out all other channels (signals). You can measure channel power for CDMA using the CDMA Analyzer or CDMA Over Air tool. For other modulation formats, use their respective analyzers (that is, GSM, 1xEV-DO, or W-CDMA) or measure channel power using either the spectrum analyzer or the Channel Scanner tool.

NOTE If you have not done so, measure the loss of the high power attenuator by using the Insertion Loss measurement. Refer to [“Two Port Insertion Loss” on page 55](#).

NOTE Connect the Power Meter as close as possible to the power amplifier/duplexer output. Do not use a coupled port. The levels of the sensors do not function well at

the levels provided by a coupled port.

Making a Basic Average Power Measurement

To make an average power measurement, you connect the power sensor and cable, zero and calibrate the meter, and then take a reading.

When should you zero the Power Meter?

- Every time you use the Power Meter.
- When a 5 degree C. change in temperature occurs.
- Whenever you change the power sensor.
- Every 24 hours.
- Before measuring low level signals—for example, 10 dB above the lowest specified power for your power sensor.

When should you calibrate the Power Meter? Every time you cycle the power on and off.

To Make a Basic Average Power Measurement:

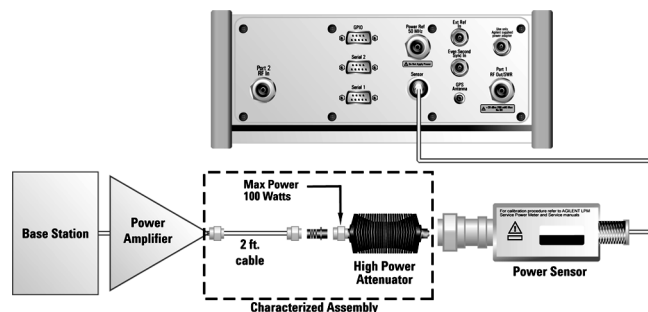
Step	Notes
1	Mode
2	[Power Meter]
3	[Zero] Follow the Zeroing Wizard, which displays instructions on the screen.
4	[Continue]
5	[Ref CF]
6	Enter the reference cal factor using the numeric keypad. The reference cal factor is printed on the label of the power sensor head.
7	[%]
8	[Calibrate]

Power Meter

Making an Average Power Measurement

Step	Notes
9	Connect the power sensor to the Power Ref 50 MHz port. The test set supports the Agilent 8482A and 8481A power sensors.
10	[Continue]
11	[Cal Factor]
12	Enter the cal factor using the numeric keypad. A list of cal factors is printed on the label of the power sensor head. Select one that's within the operating frequency of the base station. Refer to " Example of a Sensor Calibration Table (Agilent 8482A) " for an example of a power sensor calibration table. Using the example power sensor calibration table, if you were interested in 800 MHz, then: 800 MHz has a Cal Factor percentage of ~98.2 Note: Interpolate the Cal Factor from the frequency range provided on the power sensor. The example sensor calibration table shows that 800 MHz is between 300 to 1000 MHz. Since 300 MHz is listed at 98.5 and 1000 MHz (1 GHz) is at 98.1, 800 MHz would be ~98.2.
13	[%]
14	Connect the external attenuator.

Step	Notes
15	<p>If you have previously stored PM loss from an insertion loss measurement, go to the next step.</p> <p>Or</p> <p>Press [PM Loss] and enter the PM loss value.</p>
16	<p>Connect to the base station.</p> <p>Connect the power sensor to the signal to be measured. The connection is typically after the output of the power amplifier or duplexer. The connection requires, in addition to the power sensor and attenuator, a 2 ft. cable and two Type-N barrel connectors.</p>



Using the Power Meter Loss Field

Typical base stations exceed the maximum input to most power sensor heads. Therefore a pad (typically a 40 dB 100 W attenuator) is required. The measured value of the pad and connecting cables is entered into this field. This value is then used when this field is set to **On**. When this field is set to **On**, the test set will add this loss value to the true measured value indicating the displayed measured value.

Example: The base station transmits 40 dBm (10 W), the pad and RF cabling measures 42.51 dB (measured with the 2 port insertion loss measurement prior to

Power Meter

Making an Average Power Measurement

this test), and the PM loss is turned **On** (with the 42.51 dB loss value entered). The true measured level (using an 8481A sensor) is -2.51 dBm (the pad and RF cabling attenuated the signal to within the proper range for the sensor), but the displayed measured value is 40 dBm (10 W), which is correct. This also points out the importance of accurately measuring the loss of the pad and connecting cables.

Using the Power Ref Button to Verify the Sensor Is Working Properly

With the sensor head connected to the Power Ref 50 MHz RF Port and selecting Power Ref to **On**, you can verify that the sensor is working correctly. In this configuration, the power meter should indicate approximately 0 dBm (1 mW) as it reads the 50 MHz, 0 dBm RF signal.

Example of a Sensor Calibration Table (Agilent 8482A)

MHz	CF%
.1000	97.3
.3000	99.0
1.0	99.0
3.0	99.0
10.0	99.5
30.0	99.1
100	98.8
300	98.5
1000	98.1
2000	97.4
3000	98.1
4000	90.5

Setting Power Meter Resolution

You can choose from four levels of Power Meter resolution. Higher resolutions provide more accuracy but slow the measurement speed.

Step	Notes
1 [Mode]	
2 [Power Meter]	
3 [Setup]	
4 On [Resolution] select 1, 2, 3, or 4.	<p>Each time you press this softkey, the selected option changes.</p> <ul style="list-style-type: none"> • [1] = 1 • [2] = 0.1 • [3] = 0.01 • [4] = 0.001

Setting the Power Meter's High and Low End-Points

Changing the high and low end points changes the scale resolution, making it easier to view small changes in power. This does not change the range of the sensor.

Step	Notes
1 [Mode]	
2 [Power Meter]	
3 [Setup]	
4 [Low End]	
5 Enter the minimum value you want using the numeric keypad.	
6 [dBm]	
7 [Hi End]	
8 Enter the maximum scale value you want using the numeric keypad.	



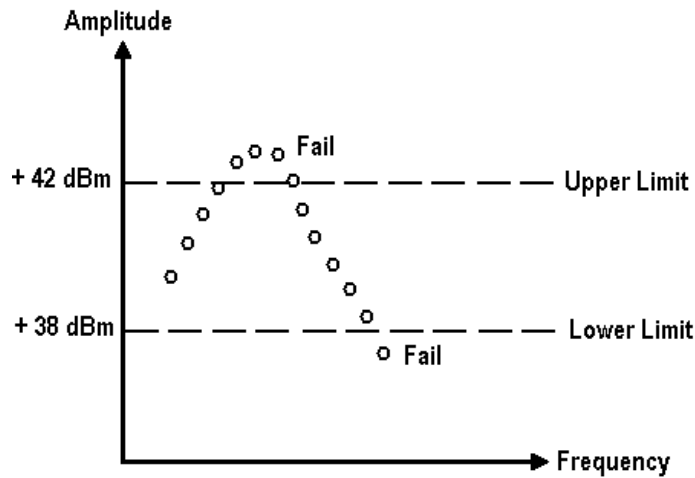
Power Meter

Making an Average Power Measurement

Step	Notes
9	[dBm]

Setting the Power Meter's Upper and Lower Limits

You can configure the Power Meter to detect when a measurement has failed predefined upper and lower limits.



Step	Notes
1	[Mode]
2	[Power Meter]
3	[Setup]
4	On [Limit] select On . Each time you press this softkey, the selected option changes.
5	[Low Limit]
6	Enter the low limit using the numeric keypad.

Step	Notes
7	[dBm]
8	[Hi Limit]
9	Enter the high limit using the numeric keypad.
10	[dBm]

Power Meter
Making an Average Power Measurement

- “Making T1 Measurements” on page 220
- “Performing a Basic T1 Analyzer Measurement” on page 220
- “Setup Button Selections” on page 220
- “Display/Sound Button Selections” on page 223
- “Control Button Selections” on page 223
- “Sample Hard Loop/End-End Full T1 BERT Test” on page 225
- “Sample Loopback CSU Full T1 BERT Test” on page 230
- “Sample Monitor Full T1 Test” on page 235
- “Sample Emulate CSU/NIU Test” on page 239
- “Sample Delay Test” on page 244
- “Turning on sound” on page 246
- “Setting up T1 diagnostics” on page 247
- “Patterns” on page 248
- “Measurement Results” on page 249
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- “Results indicators” on page 249
- “Status indicators” on page 250
- “Measurement results fields” on page 250
- “Testing and Fault Mitigation” on page 253
- “Detailed Loop Mode and Auto Configuration Descriptions” on page 258
 - “Remote CSU/NIU Loop Mode” on page 258
 - “Auto Configuration Flow Diagram” on page 262
- “Terminology” on page 264

Making T1 Measurements

The Agilent E7495A/B provide a simple solution for all your T1 testing needs, from basic transmission testing to BERT testing. For more information about T1 testing, refer to “[Measurement Results](#)” on page 249.

Performing a Basic T1 Analyzer Measurement

Step	Notes
1. [Mode]	
2. [Backhaul]	
3. [T1 Analyzer]	
4. [Get Started/ Test Mode]	The tests are listed on the buttons on the right. Pressing a test mode button will provide you with information about the test and the test options available.
5. [Setup]	Configure the T1 analyzer for the measurement.
6. [Display]	Setup your view of the measurement results.
7. [Control]	Modify the measurement setup and inject errors as you perform the measurement.

Setup Button Selections

- **Rx Input:** The Primary and Secondary inputs are both affected by this setting.
 - **Terminate** - Sets the input impedance to 100 Ohms. Can be performed only when the T1 circuit is interrupted (connected into a jack that interrupts the circuit).
 - **Monitor** - Sets the input impedance to 100 Ohms, inserts 20 dB gain, and should be selected when connected to a 'Monitor' jack.
 - **Bridge** - Sets the input impedance >1000 Ohms and should be selected when bridging on to a T1 circuit.

- **Line Code:** Configures the test set to transmit and expect to receive a line code that is compatible with the network's design. There are two types of line coding used in T1 networks:
 - **AMI** - Alternate Mark Inversion is a traditional line code.
 - **B8ZS** - Bipolar 8 Zero Substitution replaces runs of 8 zeroes with a special code that is not compatible with AMI. It allows greater flexibility of data patterns by enhancing repeater synchronization by increasing pulse density, thereby providing greater throughput.
- **Framing:** Configures the test set to transmit and expect to receive a particular framing pattern that is compatible with the network's design. It enables the test set to receive the T1 signal and to then synchronize, identify, and extract the individual channels.
 - **Unframed** - The 193rd (framing) bit is set to 0 or 1, depending on the pattern.
 - **D3/D4** - A 12 frame structure accomplished by sending a unique pattern on the 193rd (framing) bit.
 - **ESF** - A 24 frame structure accomplished by sending a unique pattern on the 193rd (framing) bit. In this mode the frame bits are used to transmit a CRC and carry information to accommodate alarms and control
- **Pattern:** Configures the test set to expect a particular test pattern. Many test patterns are available to 'stress' the circuit in a particular manner or to gain maximum insight into a particular problem.
- **Tx Pattern:** Allows you to select either Normal or Inverted patterns.
- **Tx Clock:** Configures the test set to use one of the following methods to derive the transmit clock frequency:
 - **Internal** - The transmit clock is derived within the test set and is independent of the incoming signal. This is useful when the device or line under test is configured to synchronize on the incoming signal. In this case the return clock frequency of the return signal should match the transmit clock frequency of the test set.
 - **Primary Rx** - The transmit clock frequency is derived from the signal received at the Primary Rx jack on the test set.
 - **Secondary Rx** - The transmit clock frequency is derived from the signal received at the Secondary Rx jack on the test set.
- **Channel:** Applicable only in the Channel BERT mode. Sets the active channel

T1 Analyzer

Making T1 Measurements

to be tested for BERT.

- **Fill Data:** When performing Channel BERT testing this configures the source of data transmitted in the unused slots. For drop-and-insert testing this field is typically set to Secondary Rx.
 - **All 1's** - Set this mode to maintain a sufficient 1s density on the unused channels during testing. All 1s are typically transmitted on unused channels in live T1 circuits.
 - **Idle** - Set this mode to accommodate specific troubleshooting such as to exercise a circuit designed for B8ZS.
 - **Primary Rx** - Fills the unused slots with Primary Rx data.
 - **Secondary Rx** - Fills the unused slots with Secondary Rx data.
- **Loop Code:** Selects the format of the transmitted code when a loop-up or loop-down is requested.
 - **ESF Datalink** - Loopback state change requests are sent to the far end in the framing pattern in the ESF datalink channel. Note that this mode is possible when only ESF is selected for the framing pattern.
 - **In-band** - Loopback state change requests are sent to the far end by replacing the normal channel data with the loop code. Note that in this mode the code must persist for 5 seconds for the far end to respond
- **Slip Reference:** Selects the reference for the frame slip measurement.
 - **None** - This selection disables the frame slip measurement.
 - **Internal** - In this mode the test set compares the framing of the incoming signal with the test set's internal clock. Three conditions are necessary when using this mode: the far end must be receiving a signal from this test set, the transmit clock on the far end must be configured to synchronize on the incoming signal, and the Tx Clock on this test set must be set to **Internal**.

Internal is the default selection after test set preset and covers the situation when a hard loop is configured at the far end. If a separate test set is used at each end, then the test set on one end should have the Tx Clock set to **Primary Rx** (Assuming the incoming signal is connected to this jack.) Another alternative is to use a second T1 circuit connected to the Secondary Rx jack to establish proper timing.
 - **Second Rx** - In this mode the test set compares the frame clock timing of the received signal on the Primary Rx jack with the frame clock timing of the received signal on the Secondary Rx jack.

- **Tx Line Build Out [Tx LBO]:** Sets the Tx level and pulse shape to simulate the signal conditions that would be encountered at the end of a distant transmission cable. This is useful for testing equipment suspected of having trouble receiving the signals found in typical applications.
 - 0 dB LBO = 0 dBdsx = 6 Vpp
 - -7.5 dB LBO = -7.5 dBdsx = 2.53 Vpp
 - -15 dB LBO = -15 dBdsx = 1.07 Vpp
- **Second Tx:** Selects the source of data of the signal available at the Secondary Tx jack.
 - AIS - The signal at the Secondary Rx jack is an unframed all ones aka AIS.
 - Second Rx - The Secondary Rx signal is buffered and looped back to the Secondary Tx jack.
 - Primary Rx - The signal at the Primary Rx jack is buffered and internally routed to the Secondary Tx jack.

Display/Sound Button Selections

Configure the following for the measurement you're doing:

- **Status:** Allows you to select which status panel is active.
- **Alarms:** Displays those errors occurring on either the primary or secondary channel, depending on your selection. Displays in the bottom-right of the screen.
- **Results:** You can choose an error and select results you want to drill down to; shows more metrics on error you select. Displays in bottom-right of screen.
- **Sound:** Works on single channels only and enables you to turn sound on and off. Use sound mostly to listen for drop outs or changes in the signal.
- **Volume:** Enables you to set the volume of speaker output.

Control Button Selections

On the Control button, the available buttons are unique to the test mode you select. Once you set up your display, you can change settings such as patterns, alarm injections, and so forth, while you make the measurement.

- **Pattern:** Configures the test set to expect a particular test pattern. Many test patterns are available to 'stress' the circuit in a particular manner or to gain maximum insight into a particular problem.

Making T1 Measurements

- **Alarm/Error:** Enables a list of available alarms and conditions that can be transmitted on the Primary Tx channel. The alarm or condition is invoked by pressing the Inject button.

To troubleshoot your T1 line, you can monitor for errors or alarms. Inject errors to see how the system responds.

- **Loss of Signal Alarm** - The test set ceases to send a signal.
 - **Loss of Frame Alarm** - Forces the framing bit to always be set to 1.
 - **Yellow Alarm** - The test set sends a Yellow Alarm. In D3/D4 mode, the test set sets bit #2 of each timeslot to 0. In ESF mode, the datalink bits are configured to send a repetitive pattern of 8 ones, followed by 8 zeros.
 - **AIS Alarm** - The test set sends an AIS, or 'Blue Alarm', by sending an unframed, all 1s pattern (a constant contiguous stream of 1s).
 - **Idle Alarm** - The test set sends a framed, all zero pattern. Note that the far end will interpret this as a Yellow Alarm.
 - **BPV Error** - The test set forces a single, bipolar violation error with each press of the Inject button.
 - **Frame Error** - The test set forces a single frame error with each press of the Inject button.
 - The test set forces a CRC error with each press of the Inject button only when ESF mode is selected.
 - The test set forces an error in the transmitted pattern with each press of the Inject button.
- **Fill Data:** When performing Channel BERT testing, this configures the source of data transmitted in the unused slots. For drop-and-insert testing, this field is typically set to Secondary Rx.
 - **All 1's** - Set this mode to maintain a sufficient 1s density on the unused channels during testing. All 1s are typically transmitted on unused channels in live T1 circuits.
 - **Idle** - Set this mode to accommodate specific troubleshooting such as to exercise a circuit designed for B8ZS.
 - **Primary Rx** - Fills the unused slots with Primary Rx data.
 - **Secondary Rx** - Fills the unused slots with Secondary Rx data.
 - **Inject:** Causes the error or condition that is currently displayed on the button to occur. Some selections cause a single event to occur, while others maintain a

constant state. The text on the button changes to reflect the appropriate action.

- **Loop Up/Loop Down:** Available in emulate mode, these buttons enable you to manually put the test set into either loop up or loop down mode.
- **Send Loop Up/Send Loop Down:** Available in emulate mode, the Send Loop Up button sends a loop up command to the far end. Send Loop Down sends a loop down command to the far end.

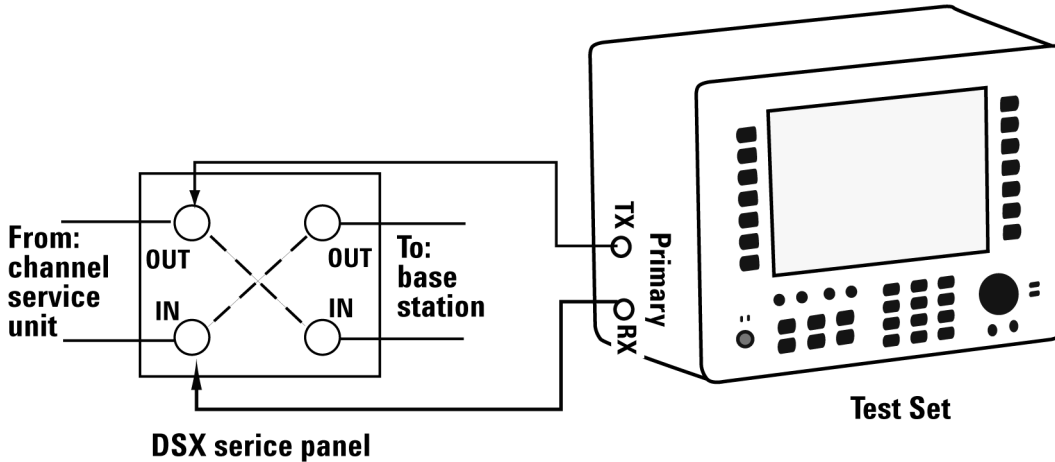
Sample Hard Loop/End-End Full T1 BERT Test

Use this test mode to perform measurements, such as BERT, on a known test pattern being sent from the far end. The far end signal can be generated by looping back the transmitted signal from this test set or by a second test set. To use this test, have someone at the far end manually loop-up the equipment or generate a known pattern with a far end test set. Since a pattern is being sent on the T1 line, service on the T1 will be affected.

This example explains how to setup a hard-loop/end-end full T1 BERT test. A hard loop test requires one test set at one end and a hard loop at the other. An end-end test requires a test set at each end but enables the troubleshooter to identify the direction of the trouble. The T1 circuit is not available for service when using this test mode.

During the commissioning or startup phase of a T1 circuit, a several day end-end or hard loop test is often performed. This type of test provides the most comprehensive level of information but does require the circuit to be taken out-of-service for the duration of the test. The test results provide more granular resolution on root cause problems than a monitor test.

Figure 11-1 Sample End to End Connection Diagram



To Perform a Hard Loop/End-End Full T1 BERT Test

Step	Notes
1	Connect the BSTS to the DSX panel Refer to Figure 11-1
2	[Mode]
3	[Backhaul]
4	[T1 Analyzer]
5	Select a test mode. <ul style="list-style-type: none"> a. [Get Started/ Test Mode] b. [Hard Loop/End-End] c. [Full T1 BERT] Use this test mode to perform measurements such as BERT on a T1 circuit. The far end signal must be derived from either a hard loop or from a second test set. The T1 circuit is not available for service when using this test mode. Select this to perform a BERT test on a full T1 Circuit.

Step	Notes
6 Setup auto configuration. a. [Auto Config] b. [Start Primary Auto Config]	Enables the Auto Configuration buttons and causes the test set to analyze the incoming T1 signal and align the setup choices to the properties of that signal.
7 [Back]	Shifts focus back to the main mode selection buttons.
8 [Setup]	Select this to display a list of setup choices that pertain to this test mode.
9 Setup the Rx input. a. [Rx Input] b. [Terminate]	This assumes the test set is connected into a jack that interrupts the T1 circuit.
10 Setup the line code. a. [Line Code] b. [B8ZS]	This assumes the circuit is designed for B8ZS (Bipolar 8 Zero Substitution). A T-carrier line code in which bipolar violations are deliberately inserted if user data contains a string of 8 or more consecutive zeros.
11 Setup the framing. a. [Framing] b. [ESF]	This assumes that the circuit has been designed for ESF. Extended Superframe Format utilizes the framing bit capacity for additional purposes. The number of frames per multiframe is expanded to 24 frames.
12 Setup the pattern. a. [Pattern] b. Use up and down buttons to select. c. [QRSS] d. [Select]	

T1 Analyzer

Making T1 Measurements

Step	Notes
13 Setup the Tx clock. a. [Tx Clock] b. [Internal]	Internal is the default selection after test set preset and covers the situation when a hard loop is configured at the far end. If a separate test set is used at each end, then the test set on one end should have the TX Clock set to Primary Rx (assuming the incoming signal is connected to this jack). Another alternative is to use a second T1 circuit connected to the Secondary Rx jack to establish proper timing.
14 Setup the Tx LBO. a. [Tx LBO] b. [0 dB]	This is a typical level found at the customer demarcation point.
15 Setup the slip reference. a. [Slip Ref] b. [None]	Disables the frame slip measurement.
16 Setup the second Tx. a. [Second Tx] b. [AIS]	Use the default condition.
17 Setup the display. a. [Display] b. [Status] c. [Pri]	Enables the [Display] options on the buttons on the right. Activates only the Primary Status pane. The inactive channel should be deactivated to cease the display of invalid measurements.
18 Setup alarms. a. [Alarms] b. [Pri]	Use this selection to observe the Primary Results in the Alarm Panel.

Step	Notes
19 Setup the results display. a. [Results] b. Use up and down buttons to select. c. [Select]	Enables a list of results information that can be displayed in the Results pane. Make a selection based on the need of the application.
20 Setup the results display. a. [Results] b. Use the up and down arrows to select. c. Make a selection. d. [Select]	Enables a list of results information that can be displayed in the Results pane. Make a selection based on the need of the application.
21 Setup the controls and select a pattern. a. [Control] b. [Pattern] c. Use the up and down buttons to select. d. QRSS e. [Select]	
22 Select the alarm. a. [Alarm/Error] b. Use the up and down buttons to select. c. Loss of Signal d. [Select]	

T1 Analyzer

Making T1 Measurements

Step	Notes
23	Inject an error.
	a. [Inject]
	b. [On]

Sample Loopback CSU Full T1 BERT Test

Use this test mode to perform a measurement, such as BERT, on a known test pattern being sent from the far end. The far end signal will be generated by looping back the transmitted signal from this test set. You will use this test set to send a code to automatically loop-up either a CSU or NIU at the far end. Since a pattern is being sent on the T1 line, service on the T1 will be affected.

Once you have selected this test mode, you can send the loop-up or loop-down code using the buttons on the Control menu. If you are using ESF, configure the appropriate ESF Loop Code on the Setup menu.

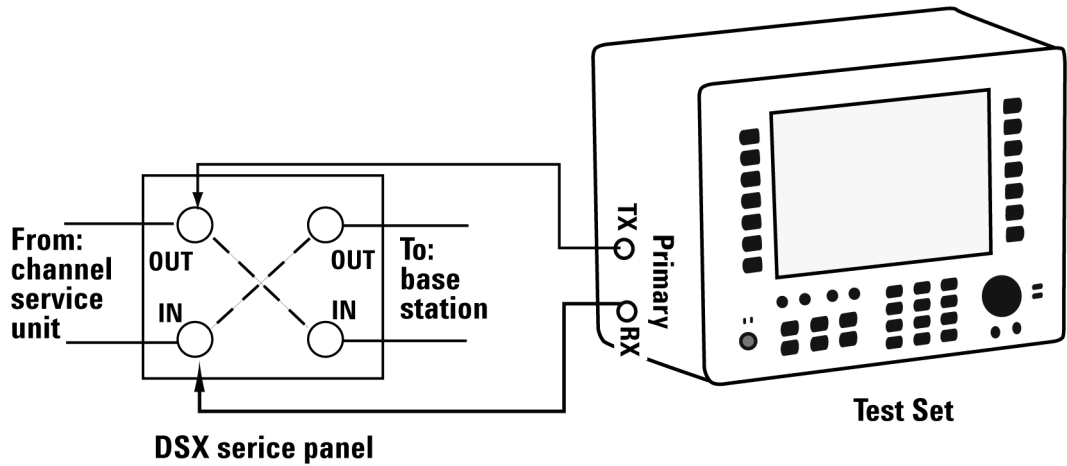
The T1 circuit is not available for service when using this test mode. End-to-end loopback tests are normally limited to the CSU since NIU loop codes are normally suppressed at the central office.

When the far end of a T1 circuit is in a remote location and trouble is suspected, it is possible to place the equipment at the far end into loopback by sending a special code designated for this purpose. If the T1 circuit is leased, then the wireless technician is often limited to looping only the CSU, as NIU loop codes are usually blocked at the central office. The loop code can be sent either in-band or on the ESF datalink channel by the test set to the far end equipment. The first method, in-band, replaces the bits in the T1 traffic channels with the unique loop code. The remote equipment must see this code for 5 seconds before it will respond in order to minimize the potential that patterns in live data will falsify this request. The downside of this technique is that all devices in the transmit path see this code and any may respond. This could lead to a confusing situation if a T1 route consists of multiple hops, each with its own CSU pair. If the far end has a hard loop then the loop code could come back to the near end and inadvertently place that CSU into loopback. The test set does monitor for a pre-existing loop and will notify you when remote loopback is attempted using an in-band loop code.

Another method is available if the circuit is designed for Extended Super Frame (ESF). This method, ESF datalink, sends the loop code on the ESF data link bits. This method is not prone to false information and, therefore, responds very rapidly. This is the default mode of the test set. For more information, see the section

detailing loopback operation.

Figure 11-2 CSU Full T1 BERT Loopback Connection Diagram



To Perform a Loopback CSU Full T1 BERT Test

Step	Notes
1	Connect the BSTS to the DSX panel Refer to Figure 11-2
2	[Mode]
3	[Backhaul]
4	[T1 Analyzer]

T1 Analyzer

Making T1 Measurements

Step	Notes	
5	Select a test mode. a. [Get Started/ Test Mode] b. [Loopback CSU/NIU] c. [CSU Full T1 BERT]	Use this test mode to perform measurements such as BERT on a T1 circuit by placing the far end CSU or NIU into a loopback state. The T1 circuit is not available for service when using this test mode. End-to-end loopback tests are normally limited to the CSU since NIU loop codes are normally suppressed at the central office. Select this to perform a BERT test on a full T1 Circuit.
6	[Setup]	Select this to display a list of setup choices that pertain to this test mode.
7	Setup Rx input. a. [Rx Input] b. [Terminate]	This assumes the test set is connected into a jack that interrupts the T1 circuit.
8	Setup line code. a. [Line Code] b. [B8ZS]	This assumes the circuit is designed for B8ZS.
9	Setup framing. a. [Framing] b. [ESF]	This assumes that the circuit has been designed for ESF.
10	Select a pattern. a. [Pattern] b. Use the up and down buttons to select. c. QRSS d. [Select]	

Step	Notes
11 Setup Tx clock. a. [Tx Clock] b. [Internal]	This is the default selection after test set preset and covers the situation when a hard loop is configured at the far end. If a separate test set is used at each end then the test set on one end should have the Tx Clock set to Primary Rx (assuming the incoming signal is connected to this jack.) Another alternative is to use a second T1 circuit connected to the Secondary Rx jack to establish proper timing.
12 Setup the Tx LBO. a. [Tx LBO] b. [0 dB]	This is a typical level found at the customer demarcation point.
13 Setup the loop code. a. [Loop Code] b. [In-band]	Your choice depends on the far end CSU configuration.
14 Setup the slip reference. a. [Slip Ref] b. [None]	Disables the frame slip measurement.
15 Setup the second Tx. a. [Second Tx] b. [AIS]	Use the default condition.
16 Setup the display. a. [Display] b. [Status] c. [Pri]	Enables the [Display] options on the buttons on the right. Activates only the Primary Status pane. The inactive channel should be deactivated to cease the display of invalid measurements.
17 Setup the alarms. a. [Alarms] b. [Pri]	This selection causes the Alarm pane to toggle between Primary and Secondary. Use this selection to observe the Primary Results in the Alarm Panel.

T1 Analyzer

Making T1 Measurements

Step	Notes
18	Setup the results display.
a.	[Results]
b.	Use the up and down arrows to select.
c.	Make a selection.
d.	[Select]
19	Setup the controls and select a pattern.
a.	[Control]
b.	[Pattern]
c.	Use the up and down buttons to select.
d.	QRSS
e.	[Select]
20	Select the alarm.
a.	[Alarm/Error]
b.	Use the up and down buttons to select.
c.	Loss of Signal
d.	[Select]
21	[Send Loop Up]
	Sends a loop up command to the far end and reports the loop state on the status line. If a pre-existing loop is detected at the far end then “Pre-existing loop” is displayed on the status line. This is only possible in In-band mode.
22	[Send Loop Down]
	Sends a loop down command to the far end and reports the loop state on the status line.

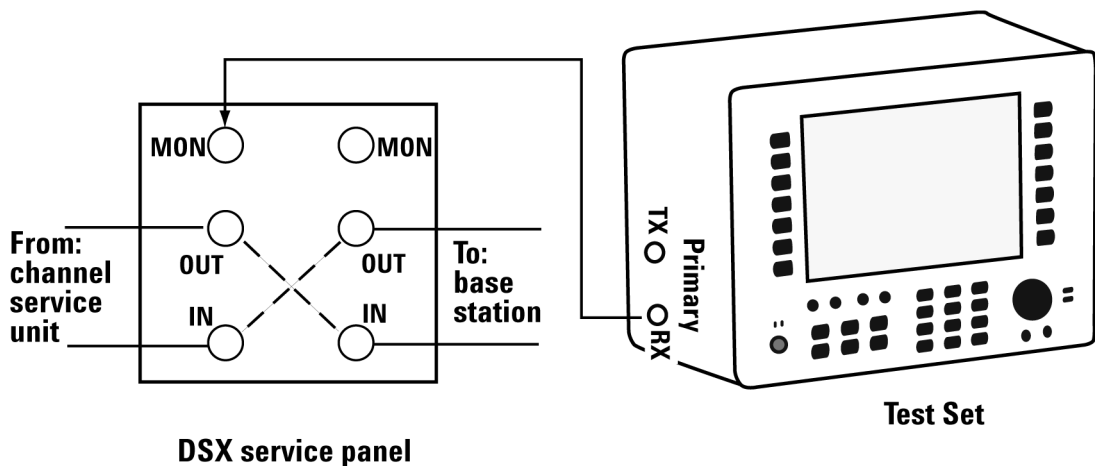
Step	Notes
23	Inject an error.
	a. [Inject]
	b. [On]

Sample Monitor Full T1 Test

Use this test mode to monitor live data on the T1 line without affecting service. The simplest hookup for monitoring does not require the test set Tx outputs to be connected. In some cases, you may connect the Tx outputs to the T1 circuit. For those cases, the Tx primary and secondary transmitted signals are regenerated from the received signal on the corresponding line.

In this example, you use the monitor test mode to test performance without disrupting service on a T1 circuit. During this test, the source of the signal from far end can be either live data or pattern data from a second test set. This mode is very similar to End-to-End Hard Loop mode, with the exception that the signal present on the Primary Tx jack is a buffered replica of the signal present on the Primary Rx jack. When monitor jacks are not available, this feature allows the technician to break into a live T1 and pass that signal through the test set, thereby keeping the circuit in-service. This is useful for monitoring long-term statistics of a T1 circuit.

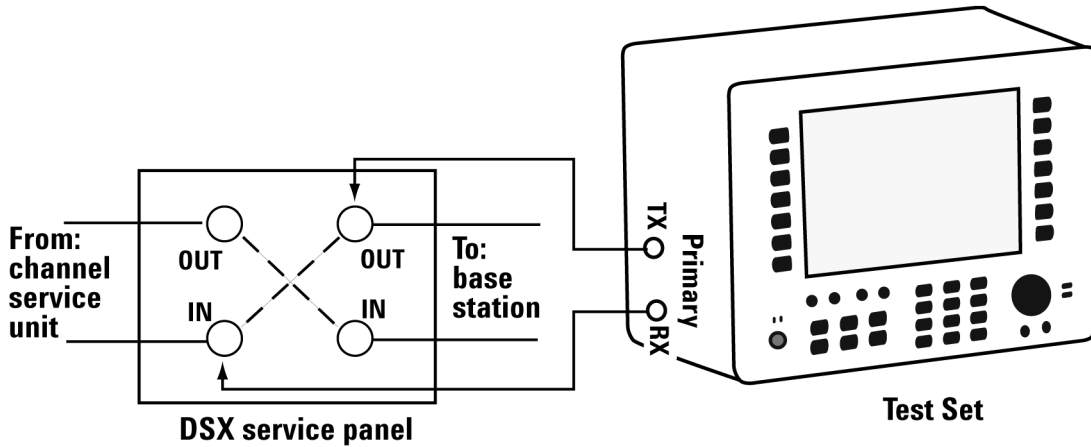
Figure 11-3 Sample Monitor Mode With Monitor Port Connection.



T1 Analyzer Making T1 Measurements

When using the above sample connection for monitoring a T1 circuit with a monitor port, you should set Rx Input to monitor.

Figure 11-4 Sample Monitor Mode Without a Monitor Port Connection



When using the above sample connection for terminating an T1 circuit, set Rx Input to terminate.

To Perform a Monitor Full T1 BERT Test

Step	Notes
1	Connect the BSTS to the DSX panel For a DSX with a monitor port connection, refer to Figure 11-3 For a DSX without a monitor port connection, refer to Figure 11-4
2	[Mode]
3	[Backhaul]
4	[T1 Analyzer]
5	[Get Started/ Test Mode]

Step	Notes	
6	Setup monitoring. a. [Monitor] b. [Monitor Full T1]	Choose this to monitor performance of a full T1 Circuit.
7	Setup auto configuration. a. [Auto Config] b. [Primary Auto Config]	Causes the test set to analyze the incoming T1 signal and align the setup choices to that signal.
8	[Back]	Shifts focus back to the main mode selection buttons.
9	[Setup]	Select this to display a list of setup choices that pertain to this test mode.
10	Setup the Rx Input. a. [Setup] b. [Rx Input] c. [Terminate]	This assumes the test set is connected into a jack that interrupts the T1 circuit. Note: If you are connected to a monitor port, select [Monitor] instead of [Terminate].
11	Setup line code. a. [Line Code] b. [B8ZS]	This assumes the circuit is designed for B8ZS.
12	Setup framing. a. [Framing] b. [ESF]	This assumes that the circuit has been designed for ESF.

T1 Analyzer

Making T1 Measurements

Step	Notes	
13	Select a pattern. a. [Pattern] b. Use the up and down buttons to select. c. QRSS d. [Select]	Set to the pattern sent by the far end.
14	Setup Tx clock. a. [Tx Clock] b. [Internal]	This selection is not applicable in Monitor mode because the Primary Tx signal is a buffered replica of the signal applied to the Primary Rx jack and is not affected by this setting. This is the default selection after test set preset.
15	Setup the Tx LBO. a. [Tx LBO] b. [0 dB]	This is a typical level found at the customer demarcation point.
16	Setup the slip reference. a. [Slip Ref] b. [None]	Disables the frame slip measurement.
17	Setup the second Tx. a. [Second Tx] b. [AIS]	Use the default condition.
18	[Display]	Enables the [Display] options on the buttons on the right.
19	Setup the display. a. [Display] b. [Status] c. [Pri]	Enables the [Display] options on the buttons on the right. Activates only the Primary Status pane. The inactive channel should be deactivated to stop the display of invalid measurements.

Step	Notes	
20	Setup the alarms. a. [Alarms] b. [Pri]	This selection causes the Alarm pane to toggle between Primary and Secondary. Use this selection to observe the Primary Results in the Alarm Panel.
21	Setup the results display. a. [Results] b. Use the up and down arrows to select. c. Make a selection. d. [Select]	Make a selection based on the need of the application.
22	[Control]	The selection enables several soft keys on the right that control choices specific to each test mode.
23	Select a pattern. a. [Pattern] b. Use the up and down buttons to select. c. QRSS d. [Select]	Select a pattern.

Sample Emulate CSU/NIU Test

The purpose of this test mode is to emulate a CSU or NIU. The test set will terminate the T1 line, and a loop-up code sent from the far end will cause this test set to enter a loopback state. Conversely, a loop-down code sent from the far end will cause this test set to exit the loopback state.

If you are using ESF, configure the appropriate ESF Loop Code on the Setup menu.

In this example, you use the emulate CSU/NSU test mode to have the test set emulate a CSU or NIU at the near end. In this mode it is possible for the far end to place this test set into loopback mode. The T1 circuit is not available for service

T1 Analyzer

Making T1 Measurements

during loopback. Loopback tests are normally limited to the CSU since NIU loop codes are normally suppressed at the central office. When the test set is in a loopback state, AIS is present at the Secondary Tx jack. When not in loopback state, the Primary Rx signal is routed to the Secondary Tx jack and the Secondary Rx signal is routed to the Primary Tx jack.

NOTE

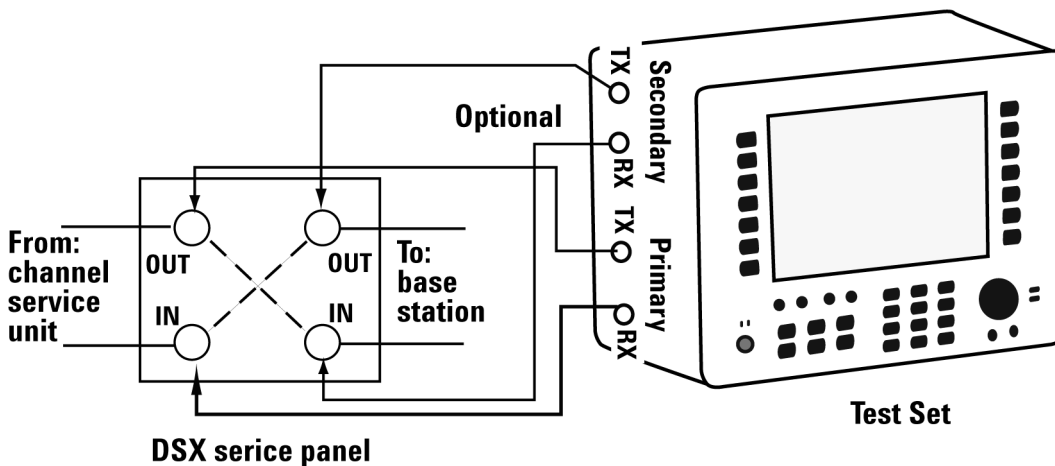
Avoid having a hard loop in the Secondary channel as it will cause a constant loop condition to exist.

You may want to emulate the functionality of a CSU/NIU if trouble is suspected in that equipment. The wireless technician will often be interested in only the CSU mode. The functionality of a CSU is emulated in this mode and the test set will respond to loop codes received at the Primary Rx input.

The test set has the capability to emulate the functionality of a CSU/NIU.

The test set will respond only to the type of loop code selected on the setup screen. Be aware that when the test set is not in loopback mode, the source of data on the Primary Tx jack is the Secondary Rx jack, and the source of data on the Secondary Tx jack is the Primary Rx jack. If B8ZS is selected on the test set, then the signal (or no signal - which is decoded as all zeros) will be translated to B8ZS format.

Figure 11-5 Sample Emulate CSU/NIU Test Setup



The following table provides the data source for primary Tx and secondary Tx

during loop-up and loop-down states in emulate mode.

Data Source in Emulate Mode

Jack	Loop Up	Loop Down
Primary Tx	Primary Rx	<ul style="list-style-type: none">• AIS when no signal present at Secondary Rx• Secondary Rx
Secondary Tx	Secondary Rx	<ul style="list-style-type: none">• AIS

T1 Analyzer

Making T1 Measurements

Sample Emulated CSU/NIU Test:

Step	Notes
1	Connect the BSTS to the DSX panel Refer to Figure 11-5
2	[Mode]
3	[Backhaul]
4	[T1 Analyzer]
5	Select a test mode. Choose this to emulate a CSU. a. [Get Started/ Test Mode] b. [Emulate CSU/NIU] c. [Emulate CSU]
6	[Setup] Select this to display a list of setup choices that apply to this test mode.
7	Setup Rx input. This assumes the test set is connected into a jack that interrupts the circuit. a. [Rx Input] b. [Terminate]
8	Setup line code. This assumes the circuit is designed for B8ZS. a. [Line Code] b. [B8ZS]
9	Setup framing. This assumes that the circuit has been designed for ESF. a. [Framing] b. [ESF]

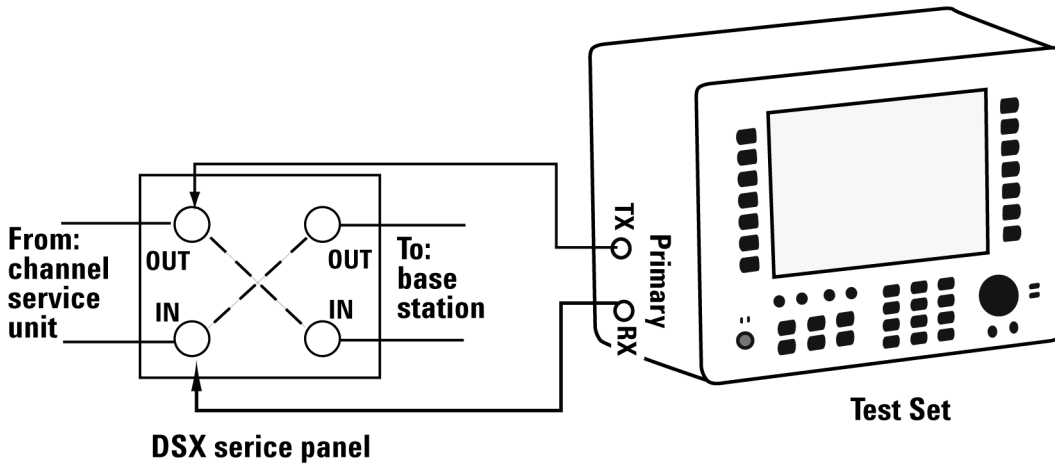
Step	Notes
10 Select a pattern. a. [Pattern] b. Use the up and down buttons to select. c. QRSS d. [Select]	
11 Setup Tx LBO. a. [Tx LBO] b. [0 dB]	This is a typical level found at the customer demarcation point.
12 [More 1 of 2]]	Displays the rest of the Setup options.
13 Setup the loop code. a. [Loop Code] b. [ESF Data Link]	Configures what type of loop code this test set will respond to. Requires a Datalink loop code for this test set to enter loopback mode.
14 [Display]	Enables the Display options on the buttons on the right.
15 Setup the results display. a. [Results] b. Use the up and down arrows to select. c. Make a selection. d. [Select]	Enables a list of results information that can be displayed in the Results pane. Make a selection based on the need of the application.
16 [Control]	The selection enables several soft keys on the right that control choices specific to each test mode.
17 [Pattern]	Select a pattern.
18 [Self Loop Up]	Forces the test set to enter loop-up state.
19 [Self Loop Down]	Forces the test set to enter loop-down state.

Sample Delay Test

Use this test mode to measure the delay between the primary Tx and Rx ports. This measured delay can be used to determine the approximate distance between near end and the far end. The far end of the line must be manually looped during this test. Since a signal is being sent on the T1 line, service on the T1 will be effected.

In this example, you can use this test mode to have the test set measure the round trip delay of a T1 circuit. It is necessary to have a loop condition at the far end during this test. The best accuracy is obtained when a hard loop exists at the far end. The far end CSU can be remotely looped up using the CSU/NIU Loopback mode, however, be aware that the loopback method in the remote device could add additional delay. During this mode a pattern consisting of a zero inserted into a string of ones is transmitted and analyzed to determine the delay in the path. The selected test pattern is sent as filler during the calculation interval.

Figure 11-6 Delay Connection Diagram



Sample Delay Test

Step	Notes	
1	Connect the BSTS to the DSX panel	
2	[Mode]	
3	[Backhaul]	
4	[T1 Analyzer]	
5	Select a test mode. a. [Get Started/ Test Mode] b. [Delay] c. [Full T1]	Choose this to perform a Delay test on a full T1 Circuit. Delay measurements require full T1 bandwidth.
6	[Setup]	Select this to display a list of setup choices that pertain to this test mode.
7	Setup Rx input. a. [Rx Input] b. [Terminate]	This assumes the test set is connected into a jack that interrupts the circuit.
8	Setup line code. a. [Line Code] b. [B8ZS]	This assumes the circuit is designed for B8ZS.
9	Setup framing. a. [Framing] b. [ESF]	This assumes that the circuit has been designed for ESF.

T1 Analyzer

Making T1 Measurements

Step	Notes
10	Select a pattern. <ol style="list-style-type: none">[Pattern]Use the up and down buttons to select.QRSS[Select]
11	Setup Tx LBO. <ol style="list-style-type: none">[Tx LBO][0 dB]
	This is a typical level found at the customer demarcation point.

Turning on sound

You can listen to a single channel at a time in channel test mode. Sound is disabled when you are in full T1 test mode.

To Turn On the Sound

Step	Notes
1.	[Mode]
2.	[Backhaul]
3.	[T1 Analyzer]
4.	[Get Started/Test Mode]
5.	Select a measurement.
6.	Select Channel mode.
7.	[Display/Sound]
8.	[Sound]
9.	[On] or [Off]
	Each time you press this softkey, the selected option changes.

Step	Notes
10. Set the volume.	
a. [Volume]	
b. Enter the volume level from 1 - 10.	
c. [Enter]	

Setting up T1 diagnostics

The diagnostic tests available for T1 include:

- **RAM** - During the RAM test, the memory on the T1 measurement module is tested. Any memory hardware failures are detected.
- **ROM** - The ROM test verifies the integrity of the code by performing a checksum measurement.
- **Loop Back** - The loop back test is a functional test of the transmitting and receiving hardware. It attempts to send various signal patterns and levels and then to verify the measured values. It is important that this test be done using the short jumpers as even a 4-6 foot cable can cause a normally good board to fail.

If any of the above tests fail, contact your service center.

To Set Up T1 Diagnostics

Step	Notes
1. [Mode]	
2. [Backhaul]	
3. [T1 Analyzer]	
4. [Tests]	
5. [Verification]	The “Connect the T1 Patch Plugs” diagram and explanation in the instrument contain the information you need to set up the test.
6. [Continue]	The test is performed and results are reported on the screen.

Patterns

Many test patterns are available to 'stress' the circuit in a unique way or to gain maximum insight into a particular problem. Much has been written to guide the troubleshooter to select the proper pattern. Below is a summary of the qualities of the patterns available in the test set.

- **1:7** - An eight-bit pattern that contains a single one. Used to test clock recovery.
- **2 in 8** - An eight bit pattern with two ones and a maximum of four consecutive zeroes. B8ZS is never sent.
- **3 in 24** - A twenty-four bit-pattern containing 3 ones with the longest length of consecutive zeroes constrained to fifteen. It has a ones density of 12.5% and is used to check clock recovery.
- **All 1's** - A pattern that causes line drivers to consume the maximum amount of current. If framing is set to 'Unframed' the resulting pattern is equivalent to a 'Blue Alarm' or 'Alarm Indication Signal' or AIS.
- **All 0's** - A pattern that is often selected to verify B8ZS provisioning.
- **QRSS** - A pseudorandom pattern that simulates live traffic on a circuit. It is a very common test pattern
- **T1-DALY** - A pattern that changes rapidly between high and low density. This pattern is used to stress ALBO, equalizer and timing recovery circuits.
- **55 Octet** - Similar to the T1-DALY pattern except that it contains runs of fifteen consecutive zeroes that violate ones density requirements if sent unframed.
- **2E15-1** - A pseudorandom pattern based on a 15 bit shift register.
- **2E20-1** - A pseudorandom pattern based on a 20 bit shift register.
- **2E23-1** - A pseudorandom pattern based on a 23 bit shift register.
- **Alternating Ones and Zeroes** - A pattern that alternates between ones and zeroes.

Measurement Results

Alarm indicators

- **Signal Loss** - The test set encountered the absence of 192 or more consecutive pulses. A frame pulse may or may not be present
- **Frame Loss** - The test set encountered an unexpected frame pattern. The frame pattern did not match that selected in 'Setup'
- **Excess Zeros** - The test set encountered the absence at least 16 consecutive pulses in AMI mode, or the absence of at least 8 consecutive pulses in B8ZS mode.
- **All Ones** - The test set encountered an unframed, all 1s pattern (a constant contiguous stream of 1s). This pattern is also known as an Alarm Indication Signal (AIS), 'Keep-Alive Signal', or 'Blue Alarm'. Blue alarms are generated by faulty transmission equipment such a T3 to T1 multiplexers.
- **Yellow Alarm** - A Remote Alarm Indication (RAI) signal pattern was received. This is normally sent by the far end interface equipment (CSU) in response to receiving a blue alarm on its network side. In D4 framing mode, a yellow alarm is created at the far end by setting bit 2 to 0 for 255 consecutive frames. In ESF, a pattern of eight 0s and eight 1s is repeated 16 times to indicate a yellow alarm.
- **Idle (CDI)** - A Customer Disconnect Indication signal was received from the far end interface unit indicating that the customer is no longer supplying a signal. A CDI signal is an in-band pattern 0001 0100. Eight ones followed by eight zeros interrupted each second for 100 ms with LAPD Idle code (01111110) will be sent in the ESF Facility Data Link (ESF FDL).

Results indicators

- **BPV** - A momentary indicator that responds when a bipolar violation occurs on the incoming signal applied to the Receive jack. B8ZS codes are not considered a BPV and will not activate this indicator when the test set is set to AMI mode.
- **Frame** - A momentary indicator that responds when the test set encountered a disruption of the incoming frame pattern.
- **Pattern** - A momentary indicator that responds to a disruption of the incoming pattern.

- **CRC** - A momentary indicator that respond to a disruption of the incoming CRC. This indicator is applicable in only ESF mode.

Status indicators

- **T1 Pulses** - The test set is receiving pulses at the receive jack. Frame pulses alone are not sufficient to activate this indicator. There must be pulses present in the payload field.
- **B8ZS** - A B8ZS pulse pattern was detected on the incoming signal at the receive jack. Note that only certain patterns transmit B8ZS pulse patterns. The pattern must contain at least 8 consecutive zeroes before a B8ZS pattern is sent. The QRSS pattern will generate B8ZS while an idle T1 circuit transmitting all 1's will not.
- **Frame Sync** - A frame sync pattern matches that specified in the setup screen on the test set.
- **Pattern Sync** - The received pattern matches that specified in the setup screen on the test set

Measurement results fields

Recv Level

The voltage level of the signal measured at the Rx jack. (0 dBdsx = 6 Vpp)

Frequency

The frequency of the signal measured at the Rx jack. The T1 Pulses indicator must be active for this measurement to be displayed.

Elapsed Time

Indicates the amount of elapsed time since the last measurement reset.

BPV Errors

A tally of the number of BPV errors since the last measurement reset.

BPV Error Rate

The percent ratio of BPV errors to total bits transmitted since the last measurement reset.

BPV Errd Secs

The number of one second intervals since the last measurement reset that contained BPV errors.

Frame Errors

A tally of the number of Frame errors since the last measurement reset.

Frame Error Rate

The percent ratio of frame errors to total bits transmitted since the last measurement reset.

Frame Errd Secs

A tally of the number of one-second intervals since the last measurement reset that contained frame errors.

Signal Loss

A tally of the number of one-second intervals since the last measurement reset that contained signal errors.

Frame Sync Loss

A tally of the number of one-second intervals since the last measurement reset that contained frame sync loss.

Excess Zeros

A tally of the number of one-second intervals since the last measurement reset that contained excess zeros.

All 1's

A tally of the number of one-second intervals since the last measurement reset that contained the AIS pattern.

Yellow Alarm

A tally of the number of one-second intervals since the last measurement reset that contained the yellow alarm pattern.

T1 Analyzer

Measurement Results

Error Free Seconds

A tally of the number of one-second intervals that were error free since the last measurement reset.

Errored Seconds

A tally of the number of one-second intervals since the last measurement reset that contained errors such as BPVs and frame errors.

Severe Errored Seconds

A tally of the number of one-second intervals since the last measurement reset that were severely errored.

Available Seconds

A tally of the number of one-second intervals since the last measurement reset that were available for service.

Unavailable Seconds

A tally of the number of one-second intervals since the last measurement reset that were unavailable for service.

Degraded Minutes

A tally of the number of one-second intervals since the last measurement reset that were degraded.

Slip Rate

The percent ratio of frames cycle slips of the incoming signal, relative to the slip reference choice on the setup menu, since the last measurement reset.

Peak +Wander

The peak amount of positive wander, measured in bit intervals, since the last measurement reset. Each peak wander interval of 193 qualifies as a frame slip.

Peak -Wander

The peak amount of negative wander, measured in bit intervals, since the last measurement reset. Each peak wander interval of 193 qualifies as a frame slip.

+Frame Slips

A tally of the number of positive frame slips that occurred since the last measurement reset.

-Frame Slips

A tally of the number of positive frame slips that occurred since the last measurement reset.

Bit Errors

A tally of the number of bit errors that occurred since the last measurement reset.

Bit Error Rate

The percent ratio of bit errors to total bits transmitted since the last measurement reset.

Pattern Sync Loss

A tally of the number of times the pattern detector lost synchronization since the last measurement reset.

Test Data Rate

The measured data rate of the bit stream.

Testing and Fault Mitigation

The complexity of T1 testing certainly parallels or possibly exceeds that of RF tests at a cell site. Shadowing efforts and customer expression have shown that most cell site technicians reduce the complexities of backhaul T1 testing down into a series of well-defined steps. These tests are often not comprehensive, but are often sufficient to determine the continuity of a T1 circuit with a high degree of confidence. The test sequence is often developed by an experienced technician and is determined by finding the shortest path to an adequate measurement on a particular piece of readily available equipment. T1 testing often involves one technician on each end of a circuit. In the case of wireless, the technician at the switch end, very experienced at backhaul testing, is often working with a field technician who has a broader-based set of knowledge and is often less experienced in backhaul testing. The switch technician quickly develops a test procedure that involves the smallest number of verbal instructions to the field technician.

T1 Analyzer

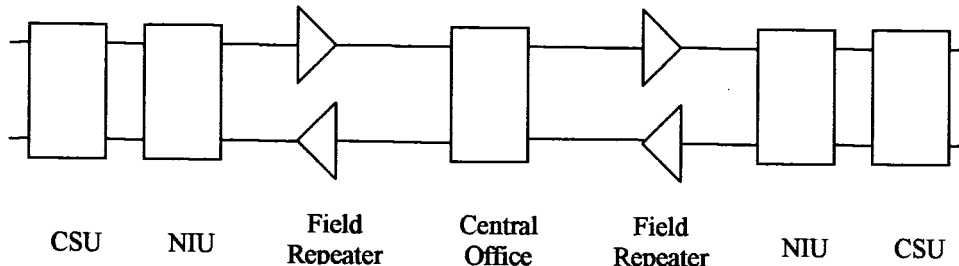
Measurement Results

T1 Facility Summary

This next section describes the elements in a typical T1 backhaul facility. Based on this information, the next section shows typical fault conditions and what procedures are typically followed to restore service to the T1 span.

With almost no exception all circuits leased from the TELCO are routed through at least one central office facility. If this were not the case, planning and managing the repeaters needed for T1 transmission would be an onerous task. Repeater facilities are need to be spaced at a distance of 6000 feet (about 1.8 km) and generally contain slots for multiple repeater units. [Figure 11-7](#) shows a typical circuit layout.

Figure 11-7 Typical T1 Circuit Layout



The following definitions apply:

Central Office: This is usually located at the geographic center of a particular service area. It is normally a building that contains the switching equipment and cable cross-connect facilities. Although this diagram shows a single central office, each end is often served by a separate central office. Facilities exist at the central office to accommodate remote testing and monitoring of T1 facilities.

Field Repeater: Repeaters are necessary when the customer is located beyond 6000 feet (about 1.8 km) from the central office. Multiple repeaters are necessary when the span exceeds 12000 feet. Most commercial customers are located within 12000 feet (about 3.6 km) of the central office. The repeaters are powered from the central office. Typically 90 volts is provided between the center-taps of the transmit and receive transformers. A particular repeater can be looped back by applying a specific loop-back tone. Often a label affixed to the cabinet denotes the loop-back tone. This may look like “FLTR A” or “FLTR B”.

NIU: A device provided by the TELCO that contains the necessary equipment to provide the expected electrical levels to the customer. This device may be active and the serves as the customer demarcation (demark) point. When this device is active it can be looped back by applying the proper loop-back code. The customer is

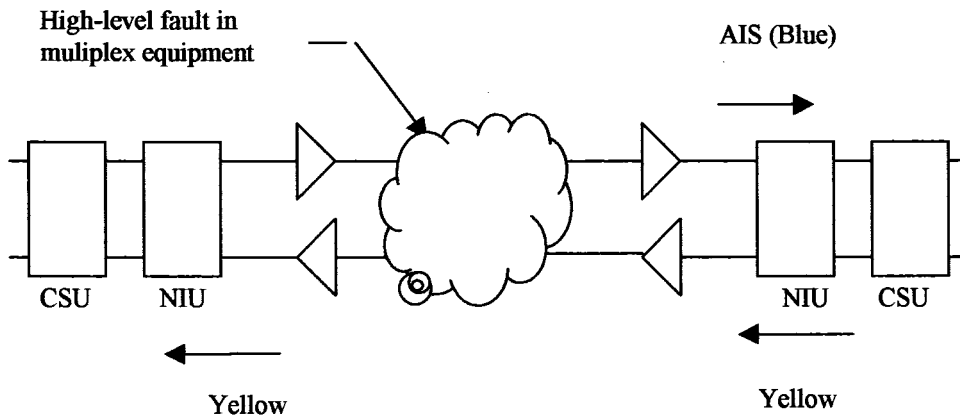
responsible for equipment beyond this point.

CSU: A customer provided unit that is required by the TELCO as part of the tariffed service agreement. This device may be looped back applying a specific loop-back code.

Isolating Faults with Alarm and Errors:

Elements in a T1 facility are subject to failure. The most common failure is due to inadvertent cable dig-ups. Fault conditions cause errors and errors cause alarms. The alarms are often remotely monitored and can be observed by test equipment attached to the circuit. The most common alarm is the Alarm Indication Signal (AIS), also known as a ‘Blue Alarm’. This alarm can be generated by a network element that not functioning or is receiving no signal. A CSU that is not receiving a signal (from the end-equipment) might generate an AIS depending on its configuration. When the CSU at the distant end sees AIS from the network it responds by sending a ‘Yellow Alarm’ back to the network. Figure 11-8 shows a typical circuit layout.

Figure 11-8 (Blue) and Yellow Alarm Diagram



The CSU is a customer-supplied device. The Network Interface Unit (NIU) is provided by the network supplier. It may be a simple passive device with terminals or an advanced electronic package such as an optical to copper interface. Some NIU devices sense the presence or absence of the CSU and, if absent, send a Customer Disconnect Indication (CDI) toward the network.

T1 Analyzer Measurement Results

Isolating Faults Using Test Equipment:

Test equipment can be used to generate and monitor alarms and errors. Test equipment is connected to the T1 facility in a variety of ways. Bantam jacks are often available on the equipment. When the plug is inserted into the jack the circuit is interrupted. Sometimes a monitor jack is available. When a plug is inserted into the monitor jack the circuit is not interrupted and a -20 dB signal is available at the jack. When none of these is available, the signal may be monitored at a connection block, sometimes referred to as a “punch-down block”. The “T1 Facility Access Methods,” table below describes the three typical access methods.

T1 Facility Access Methods

Access method	Test set configuration	Notes
Test Jacks	Terminated	Circuit is broken when plug is inserted into jack. The test equipment is normally set to “Terminate” and provides 100 Ohm termination.
Monitor Jacks	Monitor	The circuit is not interrupted when the plug is inserted into the jack. The actual signal is available at a level 20 dB lower than the original. The test set normally set to “Monitor” provides a 100 Ohm termination and expects the signal to be 20 dB down from what is usually expected.
Direct Connection to “Punch Down Block”.	Bridged	The circuit is not interrupted in this mode. The test set impedance is greater than 1000 Ohms so that the circuit is minimally affected. Test set is set to “Bridged”

WARNING

The following table describes the typical levels encountered in a T1 circuit. It is important to remember that 90 volts DC may exist between the transmit and receive pair. This voltage can be lethal!

Typical Levels Encountered in a T1 Circuit

0 dBdsx	6 Volts peak to peak
-7.5 dBdsx	2.53 Volts peak to peak

-15 dBdsx

1.07 Volts peak to peak

More Information About T1 Testing

Detailed Loop Mode and Auto Configuration Descriptions

Remote CSU/NIU Loop Mode

At each end of a T1 facility there is a Channel Service Unit (CSU) and possibly a Network Interface Unit (NIU). Both of these units have the ability to be remotely “looped up” by sending the proper loopback code. This can be done either by sending the expected loopback code in-band or out-of-band. When sent in-band, a particular pattern is transmitted on every slot for 5 seconds. When the code is sent out-of-band, the pattern is sent as part of the framing bit stream and is referred to as ‘data-link’. It is important to note that once a CSU or NIU is remotely placed into loopback, it remains in that state. When a CSU or NIU is in a loopback state, that unit will loop the in-band loop code back to the near end. If the near end CSU sees the in-band loopback code repeated from the far end CSU then both CSU units can become locked in a loopback state. The test set is designed to minimize this possibility. However, you should take precautions to prevent this from happening and be aware of this potential situation. Some CSU/NIU units do not respond to in-band loop codes when they are configured for ESF. In general, NIU loop codes will be blocked at the central office.

Figure 11-9 Flow Diagram of In-band Loop-up Code Originating from the Test Set

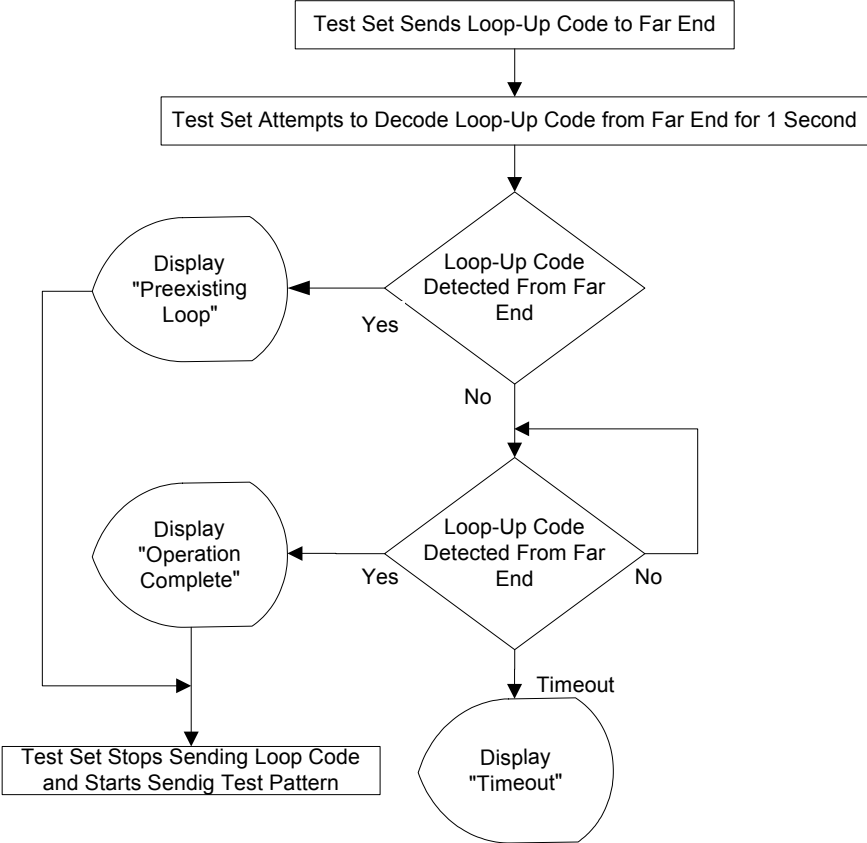
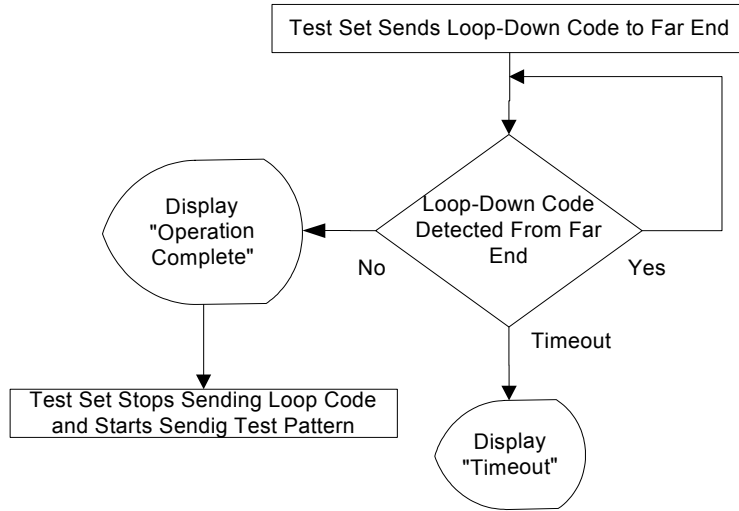


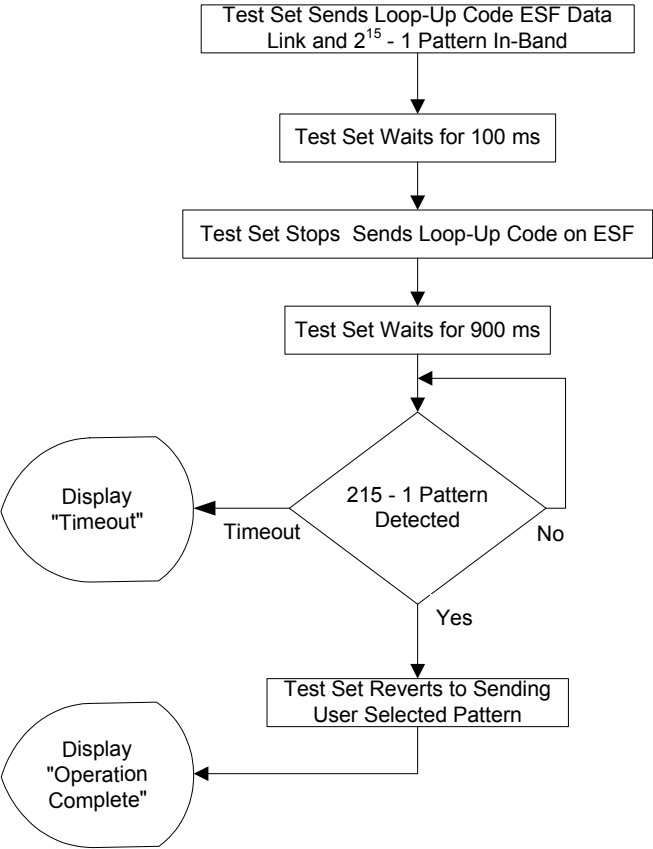
Figure 11-10

Flow Diagram of In-band Loop-down Code Originating from the Test Set



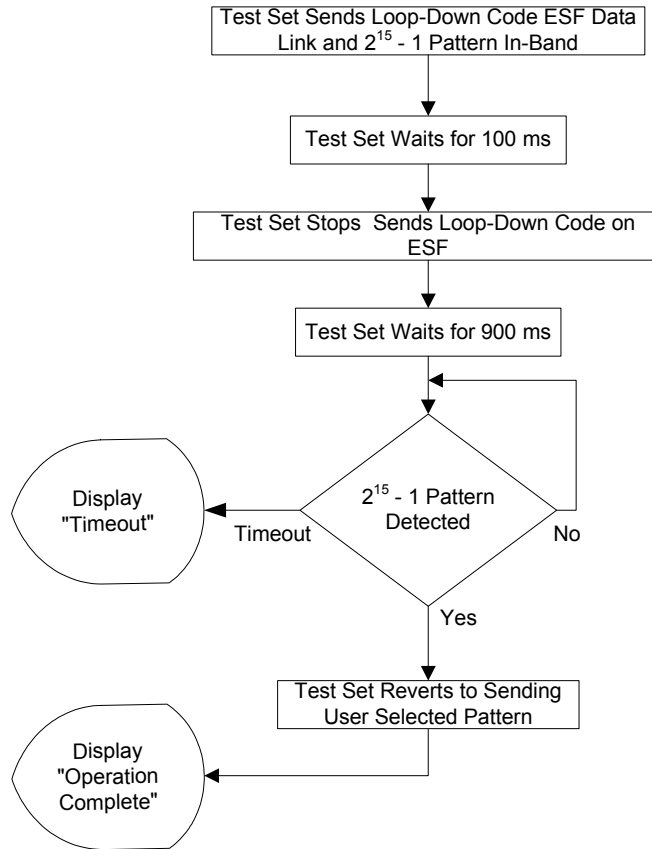
The flow of events differs when the out-of-band method of loopback is selected. In this case, loopback can occur within 16 ms, and therefore it is not possible to determine if a pre-existing loop exists.

Figure 11-11 Flow Diagram of Out-of-band Loop-up Code Originating from the Test Set



Please note that $2^{15} - 1$ (2047) pattern is used because it is normally used for fractional T1 testing and has a low probability of being present on the full T1.

Figure 11-12 Flow Diagram of Out-of-band Loop-down Code Originating from the Test Set



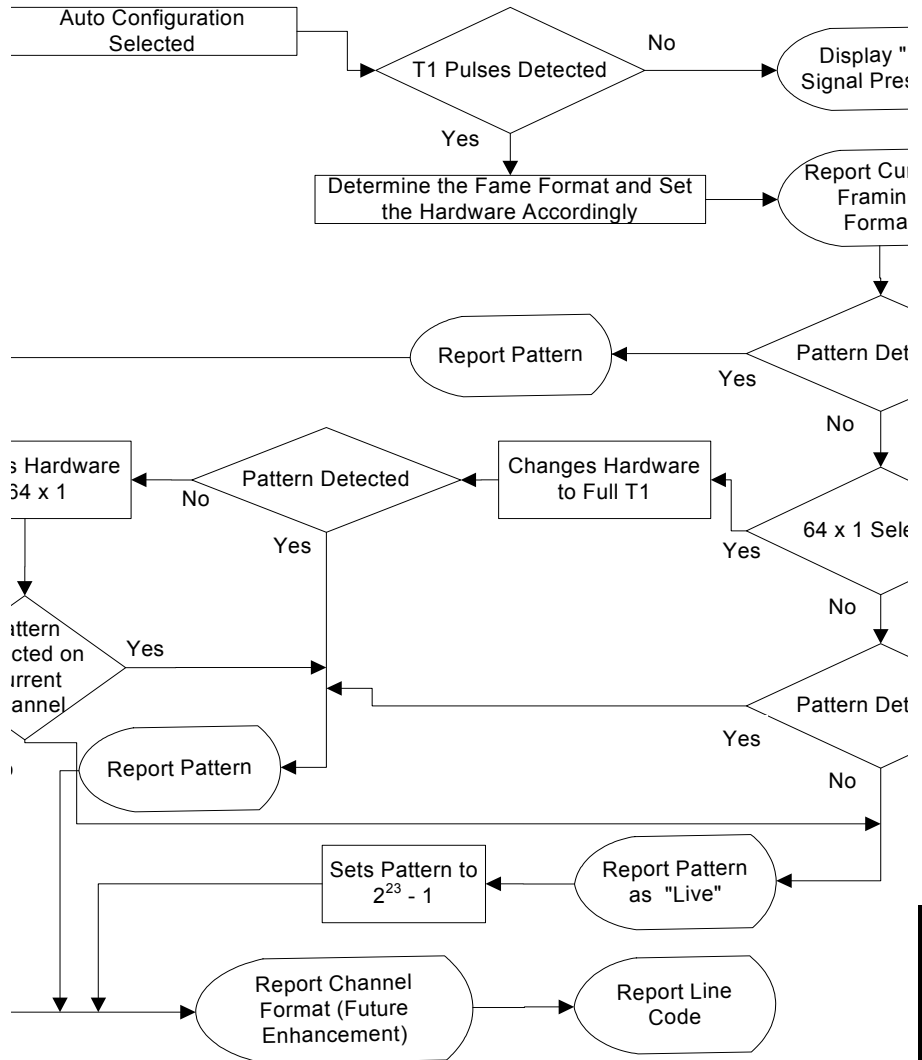
Please note that $2^{15} - 1$ (2047) pattern is used because it is normally used for fractional T1 testing and has a low probability of being present on the full T1.

Auto Configuration Flow Diagram

Selecting **Auto Config** causes the test set to analyze the incoming T1 signal and align the setup choices to that signal. If the incoming data pattern is not recognized then “NA Live Data” is displayed and the pattern selected on the setup screen will remain unchanged. If B8ZS codes are detected then this condition will be indicated and the line code parameter will be set accordingly. If setup was configured for B8ZS prior to selecting **Auto Config** and the pattern detected does not have sufficient zeros density to warrant B8ZS then “NA” will be displayed and the line

code choice in the setup screen will remain unchanged. Finally, the framing format is detected, displayed and selection changed accordingly on the setup screen.

• **Flow Diagram for Auto Configuration**



Terminology

CRC:

To an observer, the data on a live T1 Circuit appear to be random. Fortunately there is a way to perform limited testing when the circuit is designed for Extended Super Frame (ESF) format. A portion of the frame bits are reserved for a Cyclic Redundancy Checksum (CRC) sequence that can be monitored for performance. Simply stated, the CRC bits are calculated on the transmit end and inserted as a pattern on the frame bit. The CRC pattern depends on the pattern of other bits transmitted by the T1 Circuit. The receiving end also computes this pattern and compares it with the CRC that was computed and sent by the transmitting end. Since both ends use the same rules for computing the pattern, the CRC bits will be identical when all the bits involved in the computation agree. The CRC check provides good insight into the end-to-end integrity of the T1 Circuit and should be used in conjunction with other tests that can help determine what the cause of the CRC failure might be.

BPV:

The electrical signals on a properly functioning T1 circuit conform to the specification set forth in the standards. The standards specify that the presence of a voltage indicates a data '1' and the absence of a voltage represents a data '0'. Each occurrence of a data one produces a voltage for half a bit interval that is the opposite polarity of the previous bit, hence the name Alternate Mark Inversion (AMI). The alternating nature of the signal ensures that the average DC voltage is zero, allowing it to be transformer coupled. Transformer coupling ensures a high degree of common mode rejection to the equipment that processes T1 signals.

Bipolar 8 Zero Substitution (B8ZS) is an exception to AMI that replaces runs of 8 consecutive zeroes with a special code that violates the AMI rules. It allows greater flexibility of data patterns by enhancing repeater synchronization by increasing pulse density thereby providing greater throughput.

When the electrical signal does not adhere to the alternating nature of the waveform specification a BiPolar Violation (BPV) has occurred. This can happen for a number of reasons, many of which are outside the control of the wireless technician. One cause may be from electrical noise radiating from florescent lamps, motors, or spark plug ignition circuits coupling into the copper lines that carry T1 signals. Shielded cable is often chosen for T1 circuits to minimize electrical interference. This shield must be grounded to be effective. When the cable is spliced or terminated the shield on both cables should be connected together. Often the transmit and receive signals are routed in separate cable bundles.

The receive signal is often much weaker than the transmit signal. Cross talk in the cable pairs can cause the transmit signal to appear on the receive pair and interfere with the low-level receive signal.

Frame:

Pulses streaming in a T1 circuit would be meaningless if there was no way to organize them in a meaningful structure. In T1, bits are organized into 192 bit frames with an associated single frame bit for a total of 193 bits. The frame bit pattern has unique characteristics that allow the receiving end to recognize it and to synchronize to it. D3/D4 framing patterns have the ability to identify a super frame of 12 sub-frames. Extended Super Frame (ESF) has the ability to identify a super frame of 24 sub-frames and include a data link channel and Cyclic Redundancy Checksum (CRC) check bits.

T1 Analyzer

More Information About T1 Testing

- “Making E1 Measurements” on page 268
- “Steps for Performing a Basic E1 Analyzer Measurement” on page 268
- “Setup Button Selections” on page 268
- “Display/Sound Button Selections” on page 271
- “Control Button Selections” on page 271
- “Sample Hard Loop/End-End Full E1 BERT Test” on page 273
- “Sample Monitor Full E1 Test” on page 276
- “Setting Up Delay Test Mode” on page 280
- “Turning On Sound” on page 283
- “Setting Up E1 Diagnostics” on page 283
- “Patterns” on page 284
- “Alarm Indicators” on page 286
- “Results Indicators” on page 286
- “Status Indicators” on page 288
- “Testing and Fault Mitigation” on page 289
- “Auto Configuration Flow Diagram” on page 291
- “Terminology” on page 293

Making E1 Measurements

The Agilent E7495A/B provide a simple solution for all your E1 testing needs, from basic transmission testing to BERT testing. For more information about E1 testing, refer to [“Measurement Results” on page 286](#).

Steps for Performing a Basic E1 Analyzer Measurement

Step	Notes
1 [Mode]	
2 [Backhaul]	
3 [E1 Analyzer]	
4 [Get Started/ Test Mode]	The tests are listed on the buttons on the right. Pressing a test mode button will provide you with information about the test and the test options available.
5 [Setup]	Configure the E1 analyzer for the measurement.
6 [Display]	Setup your view of the measurement results.
7 [Control]	Modify the measurement setup and inject errors as you perform the measurement.

Setup Button Selections

- **Rx Input:** The Primary and Secondary inputs are both affected by this setting.
 - **Terminate** - sets the input impedance to 75 Ohms. Can be performed only when the E1 circuit is interrupted (connected into a jack that interrupts the circuit).
 - **Monitor** - sets the input impedance to 75 Ohms, inserts 20 dB gain, and should be selected when connected to a 'Monitor' jack.
 - **Bridge** - sets the input impedance >1000 Ohms and should be selected when bridging on to an E1 circuit.

- **Line Code:** Configures the test set to transmit and expect to receive a line code that is compatible with the network's design. There are two types of line coding used in E1 networks:
 - **AMI** - Alternate Mark Inversion is a traditional line code.
 - **HDB3** - High Density Bipolar 3 replaces runs of 4 zeroes with a special code that is not compatible with AMI. It allows greater flexibility of data patterns by enhancing repeater synchronization by increasing pulse density, thereby providing greater throughput.
- **Framing:** Configures the test set to transmit and expect to receive a particular framing pattern that is compatible with the network's design. It enables the test set to receive the E1 signal and to then synchronize, identify, and extract the individual channels.
 - **Unframed** - Causes the test set to simulate a loss of frame condition.
 - **PCM30** - A framing format consisting of 30 traffic channels, 1 slot reserved for the frame alignment signal (FAS) and 1 slot reserved for common channel signaling.
 - **PCM30 + CRC4** - A framing format consisting of 30 traffic channels, 1 slot reserved for the frame alignment signal (FAS) with CRC and 1 slot reserved for common channel signaling.
 - **PCM31** - A framing format consisting of 30 traffic channels, 1 slot reserved for the frame alignment signal (FAS)
 - **PCM31 +CRC4** - A framing format consisting of 30 traffic channels, 1 slot reserved for the frame alignment signal (FAS) with CRC
- **Pattern:** Configures the test set to expect a particular test pattern. Many test patterns are available to 'stress' the circuit in a particular manner or to gain maximum insight into a particular problem.
- **Tx Pattern:** Allows you to select either Normal or Inverted patterns.
- **Tx Clock:** Configures the test set to use one of the following methods to derive the transmit clock frequency.
 - **Internal** - The transmit clock is derived within the test set and is independent of the incoming signal. This is useful when the device or line under test is configured to synchronize on the incoming signal. In this case the return clock frequency of the return signal should match the transmit clock frequency of the test set.
 - **Primary Rx** - The transmit clock frequency is derived from the signal

E1 Analyzer

Making E1 Measurements

received at the Primary Rx jack on the test set.

- **Secondary Rx** - The transmit clock frequency is derived from the signal received at the Secondary Rx jack on the test set.
- **Timeslot:** Applicable only in the Channel BERT mode. Sets the active channel to be tested for BERT.
- **Fill Data:** When performing Channel BERT testing this configures the source of data transmitted in the unused slots. For drop-and-insert testing this field is typically set to Secondary Rx.
 - **All 1's** - Set this mode to maintain a sufficient 1's density on the unused channels during testing. All 1's are typically transmitted on unused channels in live E1 circuits.
 - **Idle** - Set this mode to accommodate specific troubleshooting such as to exercise a circuit designed for HDB3.
 - **Primary Rx** - Fills the unused slots with Primary Rx data.
 - **Secondary Rx** - Fills the unused slots with Secondary Rx data.
- **Slip Reference:** Selects the reference for the frame slip measurement.
 - **None** - This selection disables the frame slip measurement.
 - **Internal** - In this mode the test set compares the framing of the incoming signal with the test set's internal clock. Three conditions are necessary when using this mode:
 1. The far end must be receiving a signal from this test set.
 2. The transmit clock on the far end must be configured to synchronize on the incoming signal.
 3. The Tx Clock on this test set must be set to internal.
 - **Second Rx** - In this mode the test set compares the frame clock timing of the received signal on the Primary Rx jack with the frame clock timing of the received signal on the Secondary Rx jack.

- **Second Tx:** Selects the source of data of the signal available at the Secondary Tx jack.
 - **AIS** - The signal at the Secondary Rx jack is an unframed all ones, and is often referred to as **AIS**.
 - **Second Rx** - The Secondary Rx signal is buffered and looped back to the Secondary Tx jack.
 - **Primary Rx** - The signal at the Primary Rx jack is buffered and internally routed to the Secondary Tx jack.

Display/Sound Button Selections

Configure the following for the measurement you're doing:

- **Status:** Allows you to select which status panel is active.
- **Alarms:** Displays those errors occurring on either the primary or secondary channel, depending on your selection. Displays in the bottom-right of the screen.
- **Results:** Can choose an error and select results you want to drill down to. This shows more metrics on the error you select. Displays in bottom-right of screen.
- **Sound:** Enables you to turn sound on and off. Use sound mostly to listen for drop outs or changes in the signal.
- **Volume:** Enables you to set the volume of speaker output.

Control Button Selections

On the Control button, the available buttons are unique to the test mode you select. Once you set up your display, you can change settings such as patterns, alarm injections, and so forth, while you make the measurement.

- **Pattern:** Configures the test set to send and expect to receive a particular test pattern. Many test patterns are available to 'stress' the circuit in a particular manner or to gain maximum insight into a particular problem.
- **Alarm/Error:** Enables a list of available alarms and conditions that can be transmitted on the Primary Tx channel. The alarm or condition is invoked by pressing the Inject button.

To troubleshoot your E1 line, you can monitor for errors or alarms. You can inject errors to see how the system responds.

- **Loss of Signal Alarm** - The test ceases to send a signal.

E1 Analyzer

Making E1 Measurements

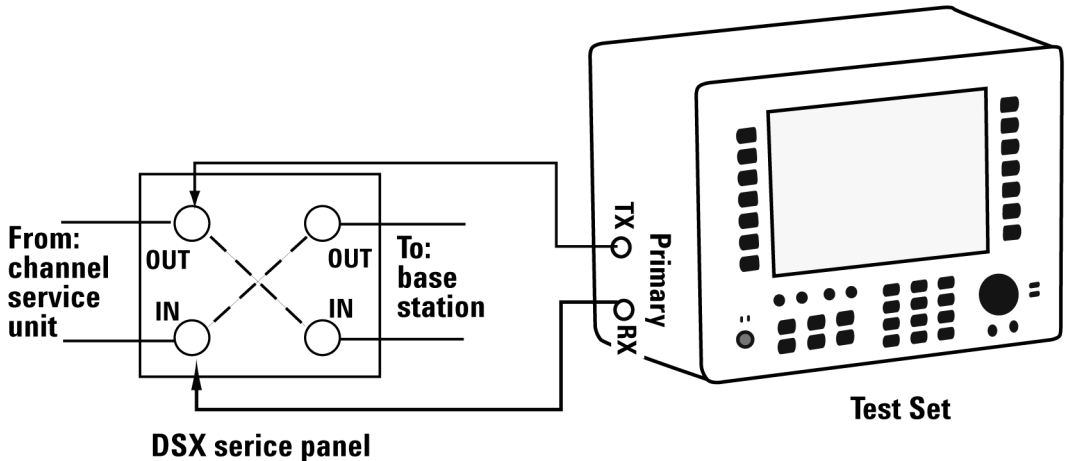
- **Loss of Frame Alarm** - Disables the frame pattern.
- **FAS Distant Alarm** - Sets the Remote Alarm Indicator bit in timeslot 0 of the odd frames to simulate an FAS distant alarm.
- **RAI Remote Alarm Indicator** - See FAS Distant Alarm (above).
- **MFAS Distant Alarm** - Sets every sixth bit of each timeslot 16 in the zero frame to simulate an MFAS distant alarm.
- **AIS Alarm** - Alarm Indication Signal (AIS) sends an unframed, all 1s pattern.
- **TS-16 AIS Alarm** - Sets all bits in timeslot 16.
- **BPV Error** - The test set forces a single bipolar violation error with each press of the Inject button.
- **FAS Error** - Causes an error in the frame alignment signal.
- **MFAS Error** - Causes an error in the multi-frame alignment signal.
- **CRC-4 Error** - Causes the test set to generate a CRC error. Note that this is possible only when CRC-4 frame modes are selected.
- **FEB (E-Bit) Error** - Causes the test set to set the E bit on odd frames.
- **Pattern Error** - The test set forces an error in the transmitted pattern with each press of the Inject button.
- **Timeslot:** Applicable only in the Channel BERT mode. Sets the active channel to be tested for BERT.
- **Fill Data:** When performing Channel BERT testing this configures the source of data transmitted in the unused slots. For drop-and-insert testing, this field is typically set to Secondary Rx.
 - **All 1's** - Set this mode to maintain a sufficient 1's density on the unused channels during testing. All 1's are typically transmitted on unused channels in live E1 circuits.
 - **Idle** - Set this mode to accommodate specific troubleshooting such as to exercise a circuit designed for HDB3.
 - **Primary Rx** - Fills the unused slots with Primary Rx data.
 - **Secondary Rx** - Fills the unused slots with Secondary Rx data.
- **Inject:** Causes the error or condition that is currently displayed on the button to occur. Some selections cause a single event to occur, while others maintain a constant state. The text on the button changes to reflect the appropriate action.

Sample Hard Loop/End-End Full E1 BERT Test

You can use this test mode to perform measurements such as BERT on an E1 circuit. This example explains how to setup a hard-loop/ene-end full E1 BERT test. A hard loop test requires one test set at one end, and a hard loop at the other. An end-end test requires a test set at each end, but enables the troubleshooter to identify the direction of the trouble. The E1 circuit is not available for service when using this test mode.

During the commissioning or startup phase of an E1 circuit, a several day end-to-end or hard loop test is often performed. This type of test provides the most comprehensive level of information, but does require that the circuit be taken out of service for the duration of the test. The test results provide more granular resolution on root cause problems than does a monitor test.

Figure 12-1 Sample End to End Connection Using a Terminate Connection with a Dsx Service Panel



Sample Hard Loop/End-End Full E1 Test:

Step	Notes
1	[Mode]
2	[Backhaul]

E1 Analyzer

Making E1 Measurements

Step	Notes
3 [E1 Analyzer]	
4 [Get Started/ Test Mode]	
5 [Hard Loop/End-End]	Use this test mode to perform measurements such as BERT on an E1 circuit. The far end signal must be derived from either a hard loop or from a second test set. The E1 circuit is not available for service when using this test mode.
6 [Full E1 BERT]	Select this to perform a BERT test on a full E1 Circuit.
7 [Auto Config]	Enables the Auto Configuration buttons.
8 [Start Primary Auto Config]	Causes the test set to analyze the incoming E1 signal and align the setup choices to the properties of that signal.
9 [Back]	
10 [Setup]	
11 Setup Rx input. a. [Rx Input] b. [Terminate]	The test set must be connected to a jack that interrupts the E1 circuit.
12 Setup line code. a. [Line Code] b. [HDB3]	This assumes the circuit is designed for HDB3 (High Density Bipolar 3). An E1-line code in which bipolar violations are deliberately inserted if user data contains a string of 4 or more consecutive zeros.
13 Setup framing. a. [Framing] b. [PCM31 + CRC4]	This assumes that the circuit has been designed for PCM31 + CRC4.
14 Setup pattern. a. [Pattern] b. [QRSS]	

Step	Notes
15 Setup Tx pattern. a. [Tx Pattern] b. [Normal]	
16 Setup Tx clock. a. [Tx Clock] b. [Internal]	This is the default selection after test set Preset and covers the situation when a hard loop is configured at the far end. If a separate test set is used at each end, then the test set on one end should have the Tx Clock set to Primary Rx (assuming the incoming signal is connected to this jack). Another alternative is to use a second E1 circuit connected to the Secondary Rx jack to establish proper timing.
17 Setup slip reference. a. [Slip Ref] b. [None]	Disables the frame slip measurement.
18 Setup second Tx. a. [Second Tx] b. [AIS]	Use the default condition.
19 [Display/Sound]	Enables the display and sound options on the buttons on the right.
20 Setup the status. a. [Status] b. [Pri]	Activates only the Primary Status pane. The inactive channel should be deactivated to cease the display of invalid measurements.
21 Setup alarms. a. [Alarms] b. [Pri]	This selection causes the Alarm pane to toggle between Primary and Secondary. Use [Pri] to observe the Primary Results in the Alarm Panel. Each time you press this softkey, the selected option changes.

E1 Analyzer

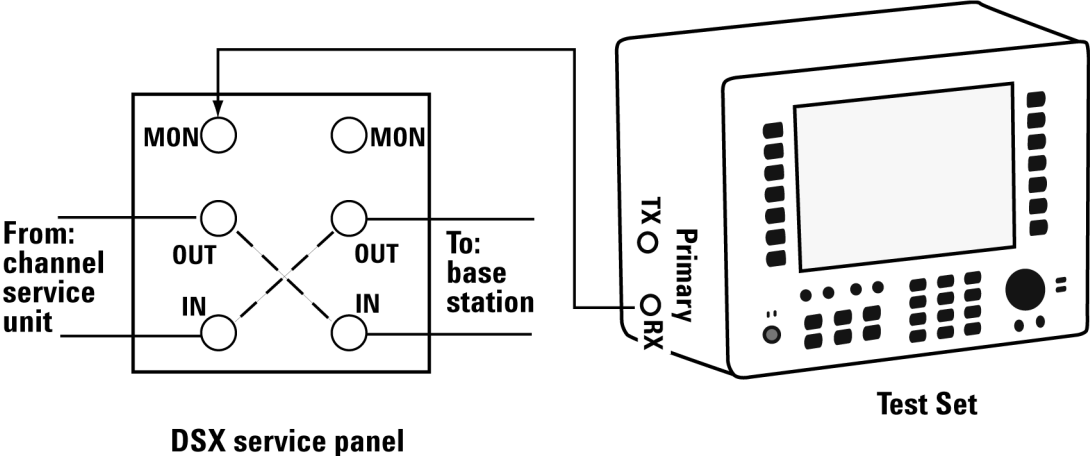
Making E1 Measurements

Step	Notes
22	Setup results display.
a.	[Results]
b.	Use up and down buttons to select.
c.	[Select]
23	Setup to inject an error.
a.	[Control]
b.	[Alarm/Error]
c.	Use the Up and Down arrow buttons to select.
d.	[Select]
e.	[Inject]

Sample Monitor Full E1 Test

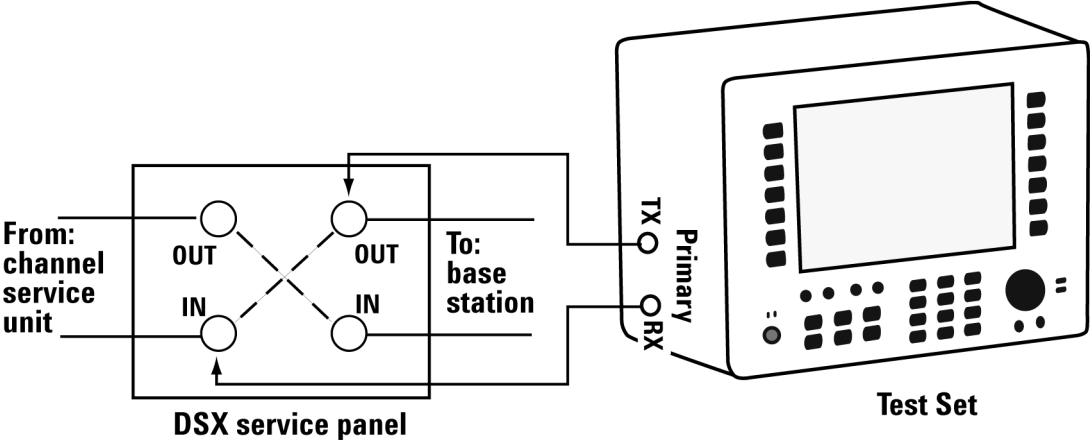
This example shows how to monitor an E1 circuit without disrupting service. During this test the source of signal from the far end can be either live data or pattern data from a second test set. This mode is very similar to End-to-End Hard Loop mode, with the exception that the signal present on the Primary Tx jack is a buffered replica of the signal present on the Primary Rx jack. When monitor jacks are not available, this feature allows the technician to break into a live E1 and pass that signal through the test set, thereby keeping the circuit in-service. This is useful for monitoring long-term statistics of an E1 circuit.

Figure 12-2 Sample Monitor Mode with a Monitor Port Connection



When using the above sample connection for monitoring an E1 circuit with a monitor port, you should set Rx Input to monitor.

Figure 12-3 Sample Monitor Mode without a Monitor Port



When using the above sample connection for terminating an E1 circuit, you should set Rx Input to terminate.

E1 Analyzer

Making E1 Measurements

To Perform a Sample Monitoring Procedure

Step	Notes
1 [Mode]	
2 [Backhaul]	
3 [E1 Analyzer]	
4 [Get Started/ Test Mode]	
5 Setup monitoring. a. [Monitor] b. [Monitor Full E1]	<p>Use this test mode to monitor live data on the E1 line without affecting service. The simplest hookup for monitoring does not require the test Set Tx outputs to be connected. In some cases, you may connect the Tx outputs to the E1 circuit. For those cases, the Tx primary and secondary transmitted signals are regenerated from the received signal on the corresponding line.</p> <p>Choose [Monitor Full E1] to monitor performance of a full E1 Circuit.</p>
6 Setup auto configuration. a. [Auto Config] b. [Primary Auto Config]	Causes the test set to analyze the incoming E1 signal and to align the setup choices to that signal.
7 [Back]	Shifts focus back to the main mode selection buttons.
8 Setup the Rx Input. a. [Setup] b. [Rx Input] c. [Terminate]	<p>This assumes the test set is connected into a jack that interrupts the E1 circuit.</p> <p>Note: If you are connected to a monitor port, select [Monitor] instead of [Terminate].</p>
9 Setup line code. a. [Line Code] b. [HDB3]	This assumes the circuit is designed for HDB3.

Step	Notes
10 Setup framing. a. [Framing] b. [PCM31 + CRC4]	This assumes that the circuit has been designed for PCM31 + CRC4.
11 Setup pattern. a. [Pattern] b. [QRSS]	Set to the pattern sent by the far end.
12 Setup Tx Pattern. a. [Tx Pattern] b. [Normal]	
13 Setup Tx clock. a. [Tx Clock] b. [Internal]	This selection is not applicable in Monitor mode because the Primary Tx signal is a buffered replica of the signal applied to the Primary Rx jack and is not affected by this setting. Internal is the default selection after test set Preset.
14 [More 1 of 2]	Displays further options. Choose [More 2 of 2] to return to the previous list of options.
15 Setup the slip reference. a. [Slip Ref] b. [None]	Disables the frame slip measurement.
16 Setup the second Tx. a. [Second Tx] b. [AIS]	Use the default condition.
17 [Display]	Enables the [Display] options on the buttons on the right.

E1 Analyzer

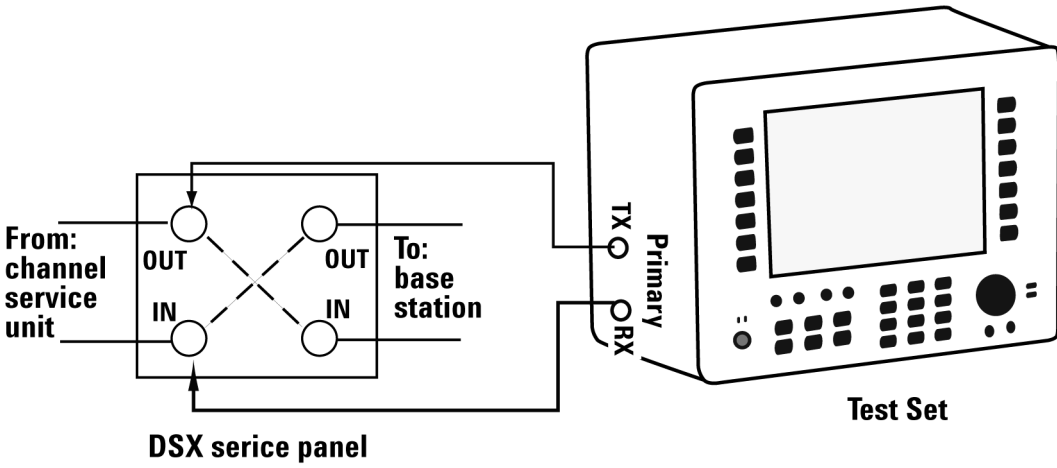
Making E1 Measurements

Step	Notes
18 Setup the status display. a. [Status] b. [Pri]	Activates only the Primary Status pane. The inactive channel should be deactivated to cease the display of invalid measurements.
19 Setup alarms. a. [Alarms] b. [Pri]	This selection causes the Alarm pane to toggle between Primary and Secondary. Use the Pri selection to observe the Primary Results in the Alarm Panel.
20 Setup the results display. a. [Results] b. Use the up and down buttons to move to the desired choice. c. [Select]	Enables a list of results information that can be displayed in the Results pane. Make a selection based on the need of the application.

Setting Up Delay Test Mode

Use this test mode to have the test set measure the round trip delay of an E1 circuit. It is necessary to have a loop condition at the far end during this test. The best accuracy is obtained when a hard loop exists at the far end. Be aware that devices placed in loopback may add additional delay. During this mode, a pattern consisting of a zero inserted into a string of ones is transmitted and analyzed to determine the delay in the path. The selected test pattern is sent as filler during the calculation interval.

Figure 12-4 Delay Connection Diagram



To Preform a Sample Delay Mode Test Procedure

Step	Notes
1 [Mode]	
2 [Backhaul]	
3 [E1 Analyzer]	
4 [Get Started/ Test Mode]	
5 Perform Delay test.	
a. [Delay]	Use this test mode to measure the delay between the Primary Tx and Rx ports. Use this measured delay to determine the approximate distance between near end and far end. The far end of the line must be manually looped during this test. Since a signal is being sent on the E1 line, service on the E1 will be affected.
b. [Full E1]	
	Delay measurements require full E1 bandwidth.

E1 Analyzer

Making E1 Measurements

Step	Notes
6 [Setup]	Select this to display a list of setup choices that pertain to this test mode.
7 Setup Rx Input. a. [Rx Input] b. [Terminate]	This assumes the test set is connected into a jack that interrupts the circuit.
8 Setup Line Code. a. [Line Code] b. [AMI] or [HDB3]	This assumes that the circuit is designed for AMI or HDB3.
9 Setup Framing. a. [Framing] b. [Unframed] or [PCM30] or [PCM30 + CRC4] or [PCM31] or [PCM31 + CRC4]	This assumes that the circuit has been designed for the option you select.
10 Setup the Pattern. a. [Pattern] b. Use the up and down arrow buttons to move to a pattern. c. [Select]	
11 Setup the Tx Pattern. a. [Tx Pattern] b. [Normal] or [Invert]	
12 Setup the Tx Clock. a. [Tx Clock] b. [Internal] or [Primary Rx]	None of the options available on [More 1 of 2] are available in Delay mode.

Turning On Sound

You can listen to a single channel at a time in channel test modes. Sound is disabled when you are in full E1 test modes.

To Turn On the Sound

Step	Notes
1 [Mode]	
2 [Backhaul]	
3 [E1 Analyzer]	
4 [Get Started/ Test Mode]	
5 [Hard Loop/End-End] or [Monitor]	
6 Select Channel mode.	
7 [Display/Sound]	
8 [Sound]	
9 [On] or [Off]	Each time you press this softkey, the selected option changes.
10 Set the volume.	
a. [Volume]	
b. Enter the volume level from 1 to 10.	
c. [Enter]	

Setting Up E1 Diagnostics

The diagnostic tests available for E1 include:

- **RAM** - During the RAM test, the memory on the E1 measurement module is tested. Memory hardware failures are detected.
- **ROM** - The ROM test verifies the integrity of the code by performing a checksum measurement.
- **Loop Back** - The loop back test is a functional test of the transmitting and receiving hardware. It attempts to send various signal patterns and levels and

E1 Analyzer

Making E1 Measurements

then to verify the measured values. It is important that this test be done using the short jumpers provided with the E7495A/B.

If any of the three tests listed above fail, contact your service center.

To Set Up E1 Diagnostics

Step	Notes
1 [Mode]	
2 [Backhaul]	
3 [E1 Analyzer]	
4 [Tests]	
5 [Verification]	The E1 Loop Cable connection diagram shown on the instrument display, and the accompanying explanation, contain the information you need to set up the test.
6 [Continue]	The test is performed and results are reported on the screen.

Patterns

Many test patterns are available to 'stress' the circuit in a unique way or to gain maximum insight into a particular problem. Much has been written to guide the troubleshooter to select the proper pattern. Below is a list of the patterns available in the test set.

- 2E6-1
- 2E9-1
- 2E11-1
- 2E15-1
- 2E20-1
- QRSS- A pseudorandom pattern that simulates live traffic on a circuit. It is a very common test pattern
- 2E23-1
- All 0's - A pattern that is often selected to verify HDB3 provisioning.

- 1:7 - An eight-bit pattern that contains a single 1. Used to test clock recovery.
- 1:4 - A 5-bit pattern with a single 1.
- 1:2 - A 3-bit pattern with a single 1.
- All 1's - A pattern that causes line drivers to consume the maximum amount of current. If framing is set to 'Unframed' the resulting pattern is equivalent to an Alarm Indication Signal (AIS).

Measurement Results

Alarm Indicators

- **Signal Loss** - The test set encountered the absence of data on the E1 signal. A frame pulse may or may not be present.
- **Frame Loss** - The test set encountered an unexpected frame pattern. The frame pattern did not match the one selected in 'Setup.'
- **AIS Alarm** - The test set encountered an unframed all-ones signal.
- **TS 16 AIS Alarm** - The test set encountered all ones in every timeslot sixteen.
- **FAS Distant Alarm** - The test set detected a FAS alarm being sent from the far end. This alarm indicator is also known as RAI (Remote Alarm Indication)
- **MFAS Distant Alarm** - The test set detected an MFAS alarm being sent from the far end.
- **Pattern Inv** - The pattern of the signal applied to the test set is inverted.

Results Indicators

- **(Code) BPV** - A momentary indicator that responds when a bipolar violation occurs on the incoming signal applied to the Receive jack. HDB3 codes are not considered a BPV and will not activate this indicator when the test set is set to AMI mode.
- **FAS** - A momentary indicator that responds to a disruption in the frame alignment signal.
- **MFAS** - A momentary indicator that responds to a disruption in the multi-frame alignment signal. This indicator is applicable in only PCM-30 framing modes.
- **CRC-4** - A momentary indicator that responds to a disruption of the incoming CRC. This indicator is applicable in only CRC-4 framing modes.
- **E-Bit** - A momentary indicator that responds to the E-bit.
- **Pattern** - A momentary indicator that responds to a disruption of the incoming pattern.
- **Frame Slip** - A momentary indicator that responds when the test set encountered a disruption of the incoming frame pattern.

- **Recv Level** - The voltage level of the signal measured at the Rx jack.
- **Frequency** - The frequency of the signal measured at the Rx jack. The E1 Pulses indicator must be active for this measurement to be displayed.
- **Elapsed Time** - Indicates the amount of elapsed time since the last measurement reset.
- **BPV Errors** - A tally of the number of BPV errors since the last measurement reset.
- **BPV Error Rate** - The percent ratio of BPV errors to total bits transmitted since the last measurement reset.
- **BPV Errd Secs** - The number of one second intervals since the last measurement reset that contained BPV errors.
- **Frame Errors** - A tally of the number of Frame errors since the last measurement reset.
- **Frame Error Rate** - The percent ratio of frame errors to total bits transmitted since the last measurement reset.
- **Frame Errd Secs** - A tally of the number of one-second intervals since the last measurement reset that contained frame errors.
- **Signal Loss** - A tally of the number of one-second intervals since the last measurement reset that contained signal errors.
- **Frame Sync Loss** - A tally of the number of one-second intervals since the last measurement reset that contained frame sync loss.
- **Excess Zeros** - A tally of the number of one-second intervals since the last measurement reset that contained excess zeros.
- **All 1's** - A tally of the number of one-second intervals since the last measurement reset that contained the AIS pattern.
- **Error Free Seconds** - A tally of the number of one-second intervals that were error free since the last measurement reset.
- **Errored Seconds** - A tally of the number of one-second intervals since the last measurement reset that contained errors such as BPVs and frame errors.
- **Severe Errored Seconds** - A tally of the number of one-second intervals since the last measurement reset that were severely errored.
- **Available Seconds** - A tally of the number of one-second intervals since the last measurement reset that were available for service.
- **Unavailable Seconds** - A tally of the number of one-second intervals since the

E1 Analyzer

Measurement Results

last measurement reset that were unavailable for service.

- **Degraded Minutes** - A tally of the number of one-second intervals since the last measurement reset that were degraded.
- **Slip Rate** - The percent ratio of frames cycle slips of the incoming signal relative to the slip reference choice on the setup menu - since the last measurement reset.
- **Peak + Wander** - The peak amount of positive wander, measured in bit intervals, since the last measurement reset.
- **Peak - Wander** - The peak amount of negative wander, measured in bit intervals, since the last measurement reset.
- **+Frame Slips** - A tally of the number of positive frame slips that occurred since the last measurement reset.
- **-Frame Slips** - A tally of the number of positive frame slips that occurred since the last measurement reset.
- **Bit Errors** - A tally of the number of bit errors that occurred since the last measurement reset.
- **Bit Error Rate** - The percent ratio of bit errors to total bits transmitted since the last measurement reset.
- **Pattern Sync Loss** - A tally of the number of times the pattern detector lost synchronization since the last measurement reset.
- **Test Data Rate** - The measured data rate of the bit stream.

Status Indicators

- **E1 Pulses** - The test set is receiving pulses at the receive jack. Frame pulses alone are not sufficient to activate this indicator. There must be pulses present in the payload field.
- **HDB3** - A HDB3 pulse pattern was detected on the incoming signal at the receive jack. Note that only certain patterns transmit HDB3 pulse patterns. The pattern must contain at least 4 consecutive zeroes before a HDB3 pattern is sent. The QRSS pattern will generate HDB3 while an idle E1 circuit transmitting all 1's will not.
- **Frame Sync** - A frame sync pattern matches the one specified in the setup screen on the test set.
- **Pattern Sync** - The received pattern matches the one specified in the setup

screen on the test set.

Testing and Fault Mitigation

The complexity of E1 testing certainly parallels or possibly exceeds that of RF tests at a cell site. Shadowing efforts and customer expression have shown that most cell site technicians reduce the complexities of backhaul E1 testing down into a series of well-defined steps. These tests are often not comprehensive but are often sufficient to determine the continuity of an E1 circuit with a high degree of confidence. Often times the test sequence is developed by an experienced technician and is determined by finding the shortest path to an adequate measurement on a particular piece of readily available equipment. E1 testing often involves one technician on each end of a circuit. In the case of wireless, the technician at the switch end, very experienced at backhaul testing, is often working with a field technician that has a broader-based set of knowledge and is often less experienced in backhaul testing. The switch technician quickly develops a test procedure that involves the least amount of verbal instructions with the field technician.

E1 Facility Summary

This next section describes the elements in a typical E1 backhaul facility. Based on this information, typical fault conditions and what procedures are typically followed to restore service to the E1 span.

With almost no exception all circuits leased from the TELCO are routed through at least one central office facility. If this were not the case, planning and managing the repeaters needed for E1 transmission would be an onerous task.

Isolating Faults Using Test Equipment

Test equipment can be used to generate and monitor alarms and errors. Test equipment is connected to the E1 facility in a variety of ways. BNC jacks are often available on the equipment. When the plug is inserted into the jack the circuit is interrupted. Sometimes a monitor jack is available. When a plug is inserted into the monitor jack the circuit is not interrupted and a -20 dB signal is available at the jack. When none of these is available the signal may be monitored at a connection block, sometimes referred to as a “punch-down block”. The table below, “E1 Facility Access Methods,” describes the three typical access methods.

E1 Facility Access Methods

E1 Analyzer

Measurement Results

Access method	Test set configuration	Notes
Test Jacks	Terminated	Circuit is broken when plug is inserted into jack. The test equipment is normally set to “Terminate” and provides 75 Ohm termination.
Monitor Jacks	Monitor	The circuit is not interrupted when the plug is inserted into the jack. The test set, when set to “Monitor”, provides a 75 Ohm connection, and expects the signal to be 20 dB lower than the original signal.
Direct Connection to “Punch Down Block”.	Bridged	The circuit is not interrupted in this mode. The test set impedance is greater than 1000 Ohms so that the circuit is minimally affected. Test set is set to “Bridged.”

WARNING

It is important to remember that 90 volts DC may exist between the transmit and receive pair. This voltage can be lethal!

More Information About E1 Testing

Auto Configuration Flow Diagram

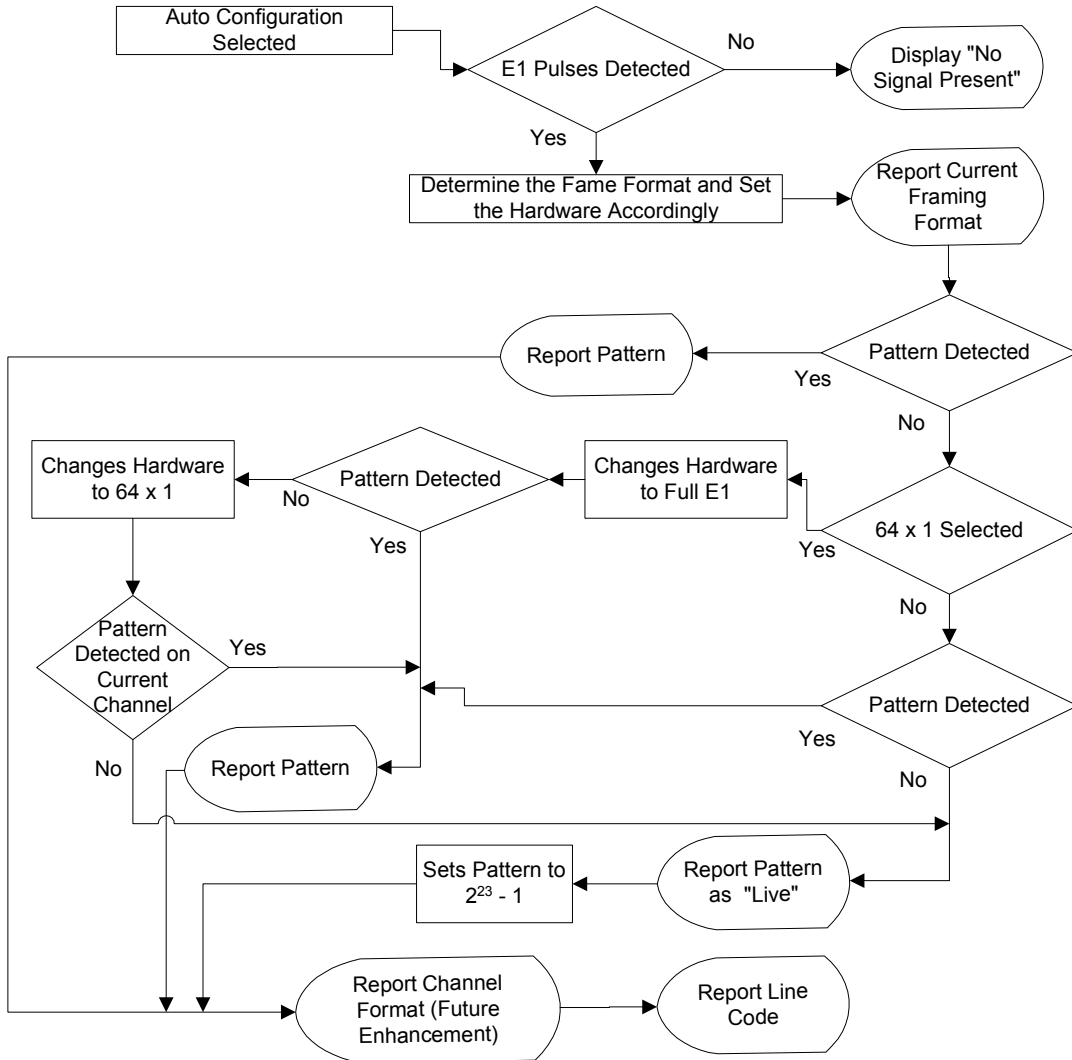
Selecting **Auto Config** causes the test set to analyze the incoming E1 signal and align the setup choices to that signal. If the incoming data pattern is not recognized, then 'NA Live Data' is displayed, and the pattern selected on the setup screen will remain unchanged. If HDB3 codes are detected, then this condition will be indicated and the line code parameter will be set accordingly. If setup was configured for HDB3 prior to selecting **Auto Config** and the pattern detected does not have sufficient zeros density to warrant HDB3, then 'NA' will be displayed, and the line code choice in the setup screen will remain unchanged. Finally, the framing format is detected, displayed and selection changed accordingly on the setup screen.

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More Information About E1 Testing

Figure 12-5

Flow Diagram for Auto Configuration



Terminology

CRC

To an observer, the data on a live E1 Circuit appears to be random. Fortunately there is a way to perform limited testing when the circuit is designed for Cyclic Redundancy Checksum (CRC) format. A portion of the frame bits is reserved for a CRC sequence that can be monitored for performance. Simply stated, the CRC bits are calculated on the transmit end and inserted as a pattern on the frame bit. The CRC pattern depends on the pattern of other bits transmitted by the E1 Circuit. The receiving end also computes this pattern and compares it with the CRC that was computed and sent by the transmitting end. Since both ends use the same rules for computing the pattern, the CRC bits will be identical when all the bits involved in the computation agree. The CRC check provides good insight into the end-to-end integrity of the E1 Circuit and should be used in conjunction with other tests that can help determine what the cause of the CRC failure might be.

BPV

The electrical signals on a properly functioning E1 circuit conform to the specification set forth in the standards. The standards specify that the presence of a voltage indicates a data '1' and the absence of a voltage represents a data '0'. Each occurrence of a data one produces a voltage for half a bit interval that is the opposite polarity of the previous bit, hence the name Alternate Mark Inversion (AMI). The alternating nature of the signal ensures that the average DC voltage is zero, allowing it to be transformer coupled. Transformer coupling ensures a high degree of common mode rejection to the equipment that processes E1 signals.

High Density Bipolar 3 (HDB3) is an exception to AMI that replaces runs of 4 consecutive zeroes with a special code that violates the AMI rules. It allows greater flexibility of data pattern by enhancing repeater synchronization by increasing pulse density thereby providing greater throughput.

When the electrical signal does not adhere to the alternating nature of the waveform specification a BiPolar Violation (BPV) has occurred. This can happen for a number of reasons, many of which are outside the control of the wireless technician. One cause may be from electrical noise radiating from florescent lamps, motors, or spark plug ignition circuits coupling into the copper lines that carry E1 signals. Shielded cable is often chosen for E1 circuits to minimize electrical interference. This shield must be grounded to be effective. When the cable is spliced or terminated, the shield on both cables should be connected together. Often the transmit and receive signals are routed in separate cable bundles.

The receive signal is often much weaker than the transmit signal. Cross talk in the

E1 Analyzer

More Information About E1 Testing

cable pairs can cause the transmit signal to appear on the receive pair and interfere with the low-level receive signal.

Frame

Pulses streaming in an E1 circuit would be meaningless if there were no way to organize the pulses into a meaningful structure.

- [“Using the CDMA Analyzer” on page 296](#)
- [“Common CDMA Tx Analyzer Measurements” on page 296](#)
- [“Preparing to Make CDMA Tx Analyzer Measurements” on page 296](#)
- [“Performing a Basic CDMA Transmitter Measurement” on page 297](#)
- [“Interpreting the Display” on page 300](#)
- [“Setting the Channel or Frequency Step” on page 302](#)
- [“Setting the PN Offset” on page 303](#)
- [“Setting the PN Increment” on page 303](#)
- [“Setting the Frequency/Time Reference” on page 304](#)
- [“Setting Units” on page 305](#)
- [“Setting the CDMA Transmitter Reference Level” on page 305](#)
- [“Setting the Active Channel Threshold Level and Auto Threshold Level” on page 306](#)
- [“Setting Measurement Time” on page 307](#)
- [“Setting Quick Page Channel” on page 308](#)
- [“Setting Average, Sweep, and Restart” on page 309](#)
- [“Adding a Marker” on page 310](#)
- [“Setting the Pass/Fail Limits” on page 312](#)
- [“Setting Up the Signal Generator” on page 320](#)
- [“Metrics Provided by the CDMA Tx Analyzer Measurement” on page 323](#)
- [“Interpretation of CDMA Tx Analyzer Measurement Results” on page 325](#)

Using the CDMA Analyzer

CDMA transmitter measurements verify proper transmitter performance and are typically made with the base station out of service. Important metrics are:

- frequency error
- PN and time offsets
- channel power
- waveform quality (estimated Rho)
- carrier feedthrough
- noise floor
- pilot channel power
- page channel delta power from pilot
- sync channel delta power from pilot
- quick changing channel delta power from pilot
- For information about CDMA over air measurements, refer to the “CDMA Over Air” chapter.

CAUTION

The maximum power for the RF In and RF Out/SWR port is 20 dBm (100 mW). The maximum power for the Power Sensor port is 24 dBm (300 mW). When directly coupled to a base station, the test set can be damaged by excessive power applied to any of these three ports.

To prevent damage in most situations when you directly couple the test set to a base station, use the high power attenuator between the test set and the BTS.

Common CDMA Tx Analyzer Measurements

Preparing to Make CDMA Tx Analyzer Measurements

The first step in measuring CDMA transmitter performance is to take the base station out of service. The next step is to choose the type of time reference available. The measurement configuration depends upon the type of time reference you choose to use. Optimally, a GPS time reference is desired. GPS provides an independent time reference that can help determine if the base station under test is synchronized with the rest of the network. Base stations not synchronized with the rest of the network are referred to as “island cells”.

NOTE

If a GPS time reference is unavailable, you must connect to the even second pulse

from the base station.

You must also know the channel or frequency and the PN (pseudo noise) Offset of the CDMA signal to be analyzed. Each base station sector has a unique PN Offset. For more information on PN Offsets refer to “Adding a Marker” on page 310.

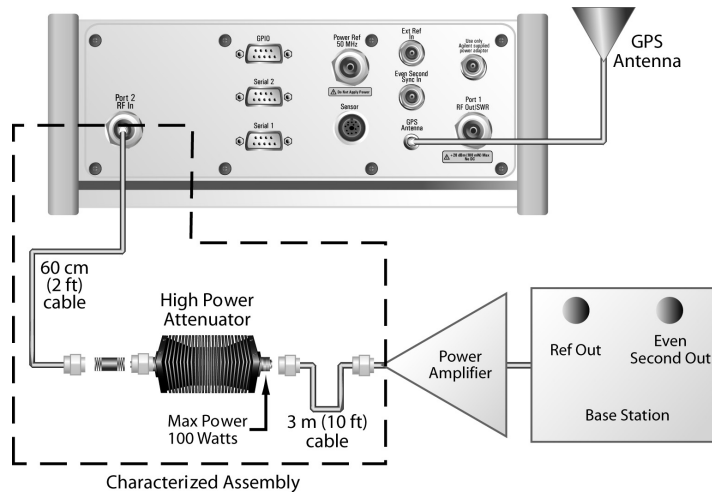
Performing a Basic CDMA Transmitter Measurement

Once you have taken the base station out of service and made the proper connections, you can perform CDMA transmitter measurements.

Step	Notes
1. Mode	
2. [Tx Analyzer]	
3. [CDMA Analyzer]	
4. [Chan Std]	
5. Highlight the channel standard you want using the up and down arrow buttons.	
6. [Select]	
7. On [Units] select Chan or Freq .	Each time you press this softkey, the selected option changes.
8. Enter the channel or frequency using the numeric keypad.	<ul style="list-style-type: none"> • If you selected Chan in the previous step, select [Channel]. • If you selected Freq, select [Frequency].
9. [Fwd]	Selects the forward CDMA channel.
10. [Fr/Time Ref]	
11. [GPS] or [External Even Sec]	GPS is the preferred time reference. If the sky (and hence the satellites) is not visible from the position of your analyzer, use External Even Sec as the time reference. When using the Even Second reference, the base station timing is relative to itself.

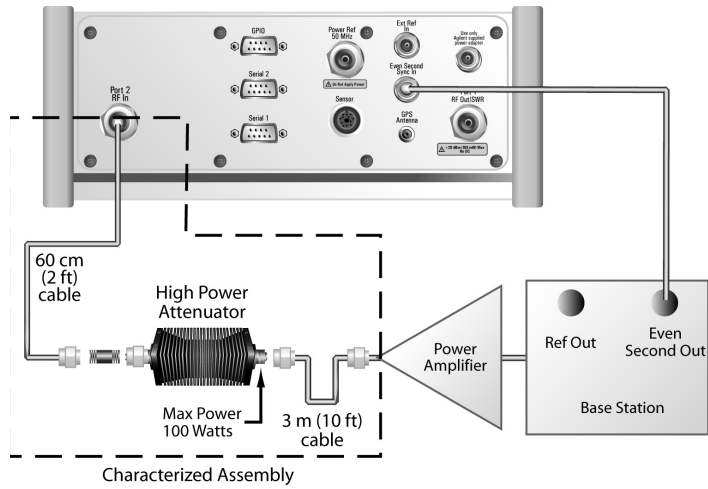
CDMA Analyzer Using the CDMA Analyzer

Step	Notes
12. On [PN Offset] select Auto or Manual .	<p>The test set defaults to Auto mode. The other choice is Manual.</p> <ul style="list-style-type: none"> In Auto mode the test set finds the PN Offset and displays the value in the metrics display at the bottom of the screen. The Time Offset is derived from the PN Offset that has been found. In Manual mode you must enter the PN Offset, which appears in the metrics display. The Time Offset is derived from the entered PN Offset.
13. Connect to the base station.	

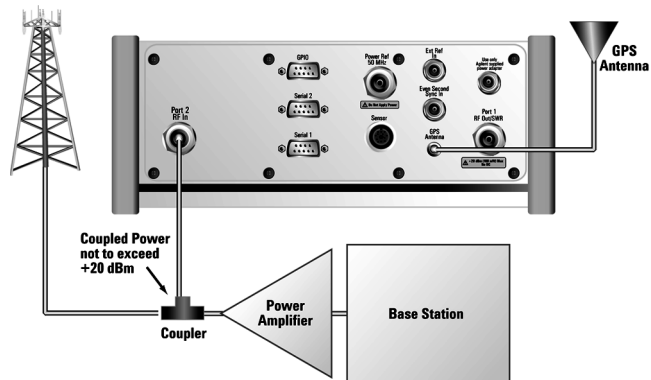


Connections for out of service CDMA measurements with GPS receiver as timing reference

Step	Notes
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Connections for out of service CDMA measurements with base station even second as timing reference



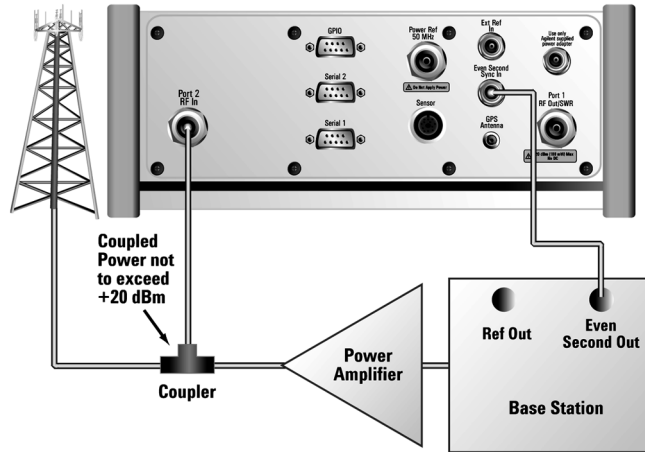
Connections for in service CDMA measurements with GPS receiver as timing reference

CDMA Analyzer

CDMA Analyzer Using the CDMA Analyzer

Step

Notes



Connections for in service CDMA measurements with base station even second as timing reference

NOTE

During a CDMA Analyzer measurement, a yellow triangle symbol may temporarily appear beside “GPS” in the lower right. The yellow triangle indicates that the test set is re-synching with the GPS even second pulse. Once the test set is synched, a green dot appears in place of the triangle. If the GPS is unavailable, a red X appears.

Interpreting the Display

The CDMA Tx Analyzer screen is divided into two sections:

- The trace display - that is, the graphic bar chart taking up most of the screen
- The metrics display - that is, a table of values at the bottom of the screen

The *trace display* contains a code domain power display. In this display 128 Walsh codes are shown in bit-reversed order to represent the combined code channels for the varying data rate traffic channels. The Y-axis labels display the relative power (dB) or absolute power (dBm), threshold level, and dB/division. The X-axis labels display active channel numbers. Active channel Walsh code numbers shown on the display include:

- Pilot (red)

- Page (green)
- Sync (blue)
- Quick page (light blue)
- IS-95 traffic (yellow)
- cdma2000 traffic (orange)
- Unknown traffic (tan)
- Noise (light gray)

The *metrics display* shows 12 measurement parameters displayed below the trace display in three columns and four rows—each with a value and units. For more information about the parameters in the metric display, refer to [“Metrics Provided by the CDMA Tx Analyzer Measurement”](#) on page 323.

The frequency indicator is at the bottom right, the time reference indicator at the bottom left. For each indicator the text indicates which reference you have chosen. A green LED indicates a locked condition, a red “X,” an unlocked condition.

Optional CDMA Tx Analyzer Measurement Settings

You can change several optional measurement parameters in the CDMA Tx Analyzer:

- “Setting the Channel or Frequency Step” on page 302
- “Setting the PN Increment” on page 303
- “Setting the CDMA Transmitter Reference Level” on page 305
- “Setting the Active Channel Threshold Level and Auto Threshold Level” on page 306
- “Setting Measurement Time” on page 307
- “Setting Quick Page Channel” on page 308
- “Setting Average, Sweep, and Restart” on page 309
- “Adding a Marker” on page 310
- “Setting the Pass/Fail Limits” on page 312

Setting the Channel or Frequency Step

You can set the channel or frequency step so you can quickly increment to the next channel or frequency using the up and down arrow buttons.

Step	Notes
1. [Chan Step] or [Freq Step]	This choice depends on the [Units] mode you are using.
2. Enter the desired channel or frequency step using the numeric keypad.	
3. [Enter]	Notice (and verify) that the number you entered (the channel step number or the frequency step number) appears below the Chan Step or Freq Step text on the corresponding button.

Setting the PN Offset

The PN Offset (Pseudo-Noise Offset) key allows you to set the analyzer to find the PN Offset automatically, or to set it to manually to a known value.

The PN Offset is a short code sequence that provides a unique identifier for each sector of each cell site. There are 512 unique offsets (0 - 511), which the access terminals use to decode the information broadcast by the access network.

Step	Notes
1. [PN Offset]	Each time you press this key, the setting toggles between Auto and Manual .
2. If you are setting the PN Offset manually, enter the PN Offset number using the numeric keypad.	Any value from 0 to 511 is valid.
3. If you are setting the PN Offset manually, press [Enter]	Notice (and verify) that the number you entered for your chosen PN Offset number appears below the PN Offset text on the corresponding button. Note that no number is displayed if the setting is Auto .

Setting the PN Increment

The PN Increment allows you to choose the increment step for the PN Offset. Typically the PN Increment is set to 1 when measuring CDMA transmitter performance while connected to the base station via RF cable.

The PN Increment field enables you to search based on a step size of your choice. If PN Increment = 1 (default), the search will step through PN values by one PN at a time. If PN Increment = 5, it will step through PN values 0, 5, 10, and so on. The Measured PN displayed will be a multiple of 5, even if the actual PN is not a multiple of 5. If you know that all base stations in the area have fixed increments, then set the PN Increment field to that increment value. If you don't know, then use the default value of 1.

CDMA Analyzer

Optional CDMA Tx Analyzer Measurement Settings

Step	Notes
1. [PN Inc]	
2. Enter the PN Increment using the numeric keypad.	The maximum value you can enter is 15.
3. [Enter]	Notice (and verify) that the number you entered for your chosen PN Increment number appears below the PN Inc text on the corresponding button.

Setting the Frequency/Time Reference

This key is used to specify the source of your frequency reference, or your frequency and time reference. The analyzer needs an accurate reference signal in order to make accurate measurements, and this is where you specify the source of this reference signal.

Step	Notes
1. [Fr/Time Ref]	The frequency/time reference form is displayed

Step	Notes
2. Select the frequency and time reference from the list using the up and down arrow buttons.	<p>If the sky (and hence the satellites) is visible from the position of your analyzer, you can select GPS to get frequency and timing references from the GPS signal. The GPS antenna will need to be attached to the analyzer.</p> <p>If you connect to the access network's Even Second Clock, you will still get all the metrics, but you will not have an independent check that the access network has locked onto the GPS signal.</p> <p>Other options available are Internal Reference, External 10 MHz, and External 19.6608 MHz. These last three options only provide a frequency reference. They do not provide a time reference...</p>
3. [Select]	

Setting Units

This key is used to toggle between **Frequency** and **Channel** for your measurements. That is, you can decide whether to specify (and measure) the frequency in Hertz, to specify the Channel Number.

Step	Notes
1. [Units]	Each time you press this key, you toggle between Freq (measurements in Hertz) and Chan (measurements by Channel Number).

Setting the CDMA Transmitter Reference Level

You can set the CDMA transmitter reference level to display either relative power (dB) or absolute power (dBm). The test set defaults to relative. The top graticule (horizontal line) represents the total power in the CDMA channel. The scale per

division is set to 5 dB per division by default, but you can change it if you wish.

If the reference level is set to relative, the reference level is relative to the total power (in dB) in the CDMA channel. If the reference level is set to absolute, the reference level displays the actual power (in dBm) in the CDMA channel.

To Set the CDMA Transmitter Reference Level:

Step	Notes
1. [Level/Location]	
2. On [Reference] select Abs or Rel.	Each time you press this softkey, the selected option changes.
3. [RF IN Loss]	
4. Enter the RF In Loss using the numeric keypad.	If you are using a cable and attenuator connected to the base station power amplifier, enter the combined cable and attenuator RF In Loss here. The RF In Loss can be obtained by measuring the Insertion loss. See “Two Port Insertion Loss” on page 55. Note: If data had been previously entered in [RF IN Loss], that data will be lost and replaced by the value you enter here.
5. [dB]	

NOTE

The insertion loss of the test cable and high power attenuator must be accounted for to obtain accurate CDMA power measurements such as channel power and pilot power. The insertion loss of the test cable/attenuator combination are accounted for as the RF In Loss, which is an offset applied to the power measurements by the test set.

Setting the Active Channel Threshold Level and Auto Threshold Level

The active channel threshold level is an advanced setting that can be set to indicate which code channels are considered active. Any code channels exceeding this power level are considered active traffic channels and any code channels below this power level are considered inactive (or noise). A horizontal red line on the screen

represents the threshold. The test set can set this level automatically, or you can manually enter a value.

In Auto mode the threshold level moves as the noise fluctuates. The threshold level is set by the test set at an optimal offset above the average noise floor. In Auto mode, you can alter the Auto Threshold Offset. The recommended and default setting is 0 dB. A negative value moves the threshold lower (closer to the noise floor) and is a more aggressive setting that increases the likelihood of interpreting an inactive channel as active. A positive value moves the threshold higher (away from the noise floor) and is a more conservative setting that increases the likelihood of interpreting an active channel as inactive.

In Manual mode the threshold level is fixed and does not move as the noise fluctuates.

To Set the Active Channel Threshold Level:

Step	Notes
1. [Setup]	
2. On [Thresh Lvl] select Auto or Manual .	Each time you press this softkey, the selected option changes. If you choose Manual, you must enter the threshold you want using the numeric keypad, then press [dB].
3. [Auto Thres Offset]	The default value is 0 dB. Optionally, you can enter a negative (more aggressive) or positive (more conservative) value, then press [dB].

Setting Measurement Time

The measurement time setting allows you to alter the speed at which measurements are made. Three choices exist: Slow, Average, and Fast. The test set defaults to Average. Slow measurement time provides a more accurate measurement at the expense of time. Fast measurement time provides a quicker measurement at the expense of accuracy. Average measurement time strikes a balance between measurement speed and accuracy.

To Set the Measurement Time:

Step	Notes
1. [Setup]	

Step	Notes
2. On [Meas Time] select Slow, Avg, or Fast.	Each time you press this softkey, the selected option changes.

Setting Quick Page Channel

With the advent of cdma2000, a new control channel called the quick page channel (QPCH) has been added. The QPCH is used to improve standby time in the phone and may or may not be enabled. The QPCH is generally channel number 80. Note that the QPCH is a bursted channel. In other words, it is not on all the time. You may have to wait to see the QPCH show up on the trace. The Delta QPCH Power parameter on the metric display can help you determine the level of the QPCH. The QPCH is also a single-wide channel: it only occupies one of the 128 channels. The pilot, paging, and sync control channels are double-wide channels and occupy two of the 128 channels on the display.

To Set the QPCH:

Step	Notes
1. [Setup]	
2. On [Quick Page Channel] select Off or Ch 80.	Each time you press this softkey, the selected option changes.

Setting Average, Sweep, and Restart

Setting the Sweep

You can select either continuous or single sweep. Continuous sweep provides repeated, ongoing measurements. Single sweep performs a single measurement that is repeated only when you push the Single button.

To set sweep:

Step	Notes
1 [Average/Sweep]	
2 [Continuous] or [Single]	Each time you press one of these softkeys, the other softkey is automatically inactivated.

Setting Averaging

You can choose to have averaging On or Off and set the number of averages you want to take. Averaging only applies to the data, not the trace. When initialized, the Agilent E7495A/B defaults to running average:

- A running average computes the new result as the weighted sum of the last result and the new measurement. The last result is weighted by $(n - 1)/n$. The new result is weighted by $1/n$. Each new measurement produces a new result.

To set averaging:

Step	Notes
1 Set the number of averages.	
a. [Average/Sweep]	
b. [Average]	
c. Enter the number of averages using the numeric keypad.	
d. [Enter]	

CDMA Analyzer

Optional CDMA Tx Analyzer Measurement Settings

Step	Notes
2	Set averaging On or Off. <ol style="list-style-type: none">[Average/Sweep][Averaging][Off] or [On]

NOTE

These two steps can be performed in any order. However, if you turn averaging on and a large number of averages has previously been set, there may be a delay before you can change number of averages.

Setting Restart

When you have averaging turned **On** and you are in **Continuous** Sweep mode, you can restart the averaging by pressing the Restart menu key. The Restart key has no effect if you are in **Single** sweep mode.

To restart averaging:

Step	Notes
1	[Average/Sweep]
2	[Restart] This key is unavailable or has no effect when Sweep is set to Single . To restart a Single Sweep measurement, press [Single].

Adding a Marker

Markers can be used on traces to help you visually track up to four signals. Each marker has the following settings:

- **Type:** Provides three options, including:
 - **Off**
 - **Normal**, which places a diamond-shaped, colored marker, along with a number, 1-4, on the trace.
 - **Delta**, is associated with a normal marker. Therefore, a normal marker must exist prior to creating the delta marker. The delta marker displays the

Optional CDMA Tx Analyzer Measurement Settings

difference between the normal marker position and the delta marker position. Only one delta marker can be associated with a given normal marker. The normal marker must be active when Delta is selected.

- **Marker to Peak:** Places the active marker on the current greatest value of the trace.
- **Marker to Next Peak:** Places the active marker on the current second greatest value of the trace.

Step	Notes
1 [Marker]	
2 [Marker]	
3 [1], [2], [3], or [4]	
4 [Type]	
5 [Off], [Normal], or [Delta]	
6 Locate the marker relative to the trace:	<ul style="list-style-type: none"> • [Marker to Peak] or • [Marker to Next Peak]

Setting the Pass/Fail Limits

The measurement limits settings enable you to alter the values of the test limits for the important measurements on the CDMA Tx Analyzer Screen. These settings affect the metrics color display: red represents fail, green represents pass. Next to the displayed measurement value, a (P) for Pass, or (F) for Fail, will be shown to further indicate whether the value is within or outside the set limits. In addition, the words “ALL PASS” or “FAILURE” are displayed in the bar at the bottom of the screen for all limits which have been turned on.

- **Frequency Error Limits:** Sets the high and low Frequency Error limits for the channel. Any measured frequency error that is outside of the set limits will result in a failure indication. The High limit is set by entering a positive number, and the Low limit is set by entering a negative number.
- **Time Offset Limits:** Sets the high and low time offset limits for the channel. Limits are set in microseconds. Any measured time offset value that is outside of the set limits will result in a failure indication.
- **Est. Rho Limit:** Sets the lower Estimated Rho limit for the channel. Any measured value of estimate Rho this is below the set limit will result in a failure indication.
- **Carrier Feedthrough Limit:** Sets the upper carrier feedthrough limit for the channel. The upper limit is set in dBc and is relative to channel power. Any measured carrier feedthrough value that is above the set limit will result in a failure indication.
- **Noise Floor Limit:** Sets the upper noise floor limits for the channel. The limit is set in dB. Any measured noise floor value above the set limit will result in a failure indication.
- **Pilot Power Limit:** Sets the upper and lower limits of the pilot power. These limits are set in dBm. Any measured pilot power value that is above or below the set limits will result in a failure indication.
- **Delta Page Power Limits:** Sets the upper and lower limits of the delta page power. The limits are set in dB and are relative to the pilot power. Any measured delta page power value that is above or below the set limit will result in a failure indication.
- **Delta Sync Power Limits:** Sets the upper and lower limit of the delta sync power. The limit is set in dB and is relative to the pilot power. Any measured Delta Sync Power value above or below the set limit will result in a failure indication.

To Set the Measurement Frequency Error Limits:

Step	Notes
1	[Setup]
2	[Limits]
3	<p>On [Freq Error Limits] select On or Off.</p> <p>Enables you to toggle the measurement limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> • If set to On, the Frequency Error will change from black to red (fail) or green (pass) and indicate either a “P” (pass) or “F” (fail). If the measured value exceeds either the upper or lower limit, the words ALL PASS in the bar at the bottom of the screen, will change to FAILURE. • If set to Off, the channel freq/number value will be displayed in blue. The area at the bottom of the screen that is used to indicate Pass or Fail will be over-written. The bar at the bottom of the screen, will indicate measurement in progress.
4	<p>Set the upper limit.</p> <ol style="list-style-type: none"> a. [High Limit] b. Enter the number on the numeric keypad. c. [GHz], [MHz], [kHz], or [Hz]
5	<p>Set the lower limit.</p> <ol style="list-style-type: none"> a. [Low Limit] b. Enter the number on the numeric keypad. c. [GHz], [MHz], [kHz], or [Hz]

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Optional CDMA Tx Analyzer Measurement Settings

To Set the Measurement Time Offset Limits:

Step	Notes
1 On [Time Offset Limits] select On or Off .	<p>Enables you to toggle the measurement limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none">• If set to On, the displayed time offset metrics will change from blue to red (fail) or green (pass) and indicate either a “P” (pass) or “F” (fail). If the measured values exceed the upper or lower limit, the words ‘ALL PASS’, in the bar at the bottom of the screen, will change to ‘FAILURE’.• If set to Off, the time offset value will be displayed in blue. The bar at the bottom of the screen will indicate measurement in progress.
2 Set the upper limit. a. [High Limit] b. Enter the number on the numeric keypad. c. [μ sec]	
3 Set the lower limit. a. [Low Limit] b. Enter the number on the numeric keypad. c. [μ sec]	

To Set the Measurement Estimated Rho Lower Limit:

Step	Notes
1 On [Est. Rho Limit] select On or Off .	<p>Enables you to toggle the measurements lower limit function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> <li>• If set to On, the displayed estimated Rho metrics will change from blue to red (fail) or green (pass) and indicate either a “P” (pass) or “F” (fail). If the measured values exceed lower limit, the words ‘ALL PASS’, in the bar at the bottom of the screen, will change to ‘FAILURE’. <li>• If set to Off, the time estimated Rho value will be displayed in blue. The bar at the bottom of the screen will indicate measurement in progress.
2 Set the lower limit. a. [Low Limit] b. Enter the number on the numeric keypad. c. [Enter]	Lower Limit range: 0 to 1

To Set the Measurement Carrier Feedthrough Upper Limit:

Step	Notes
1 On [Carr Feed-thru Limit] select On or Off .	<p>Enables you to toggle the measurement limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> If set to On, the displayed carrier feedthrough metric will change from blue to red (fail) or green (pass) and indicate either a “P” (pass) or “F” (fail). If the measured value exceeds the upper limit, ALL PASS, in the bar at the bottom of the screen, will change to FAILURE. If set to Off, the time carrier feedthrough value will be displayed in blue. The bar at the bottom of the screen will indicate measurement in progress.
2 Set the upper limit.	Upper Limit range: +100 dBc to –150 dBc
a. [High Limit]	
b. Enter the number on the numeric keypad.	
c. [dBc]	

To Set the Measurement Noise Floor Upper Limit:

Step	Notes
1 On [Noise Floor Limits] select On or Off .	<p>Enables you to toggle the measurement limit function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> If set to On, the displayed noise floor metrics will change from blue to red (fail) or green (pass) and indicate either a “P” (pass) or “F” (fail). If the measured value exceeds the upper limit, ALL PASS, in the bar at the bottom of the screen, will change to FAILURE. If set to Off, the time noise floor value will be displayed in blue. The bar at the bottom of the screen will indicate measurement in progress.

Step	Notes
2	Set the upper limit. <ul style="list-style-type: none"> a. [High Limit] b. Enter the number on the numeric keypad. c. [dB]

To Set the Measurement Pilot Power Limits:

Step	Notes
1	On [Pilot Power Limits] select On or Off . <ul style="list-style-type: none"> • Enables you to toggle the measurement limits function On (active) and Off (inactive). • If set to On, the delta pilot power metrics will change from blue to red (fail) or green (pass) and indicate either a “P” (pass) or “F” (fail). If the measured value exceeds the upper limit or lower limit, ALL PASS, in the bar at the bottom of the screen, will change to FAILURE. • If set to Off, the time pilot power value will be displayed in blue. If NO limits are set to On, the pass/fail bar will not be displayed at the bottom of the screen.
2	Set the upper limit. <ul style="list-style-type: none"> a. [High Limit] b. Enter the number on the numeric keypad. c. [dBm]
3	Set the lower limit. <ul style="list-style-type: none"> a. [Low Limit] b. Enter the number on the numeric keypad. c. [dBm]

To Set the Measurement Delta Page Power Limits:

Step	Notes
1 On [Δ Page Pwr Limits] select On or Off .	<p>Enables you to toggle the measurement limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> • If set to On, the delta page power metrics will change from blue to red (fail) or green (pass) and indicate either a “P” (pass) or “F” (fail). If the measured value exceeds the upper limit or lower limit, ALL PASS, in the bar at the bottom of the screen, will change to FAILURE. • If set to Off, the time delta page power value will be displayed in blue. If NO limits are set to On, the pass/fail bar will not be displayed at the bottom of the screen.
2 Set the upper delta limit.	Delta Limit range: –150 to 100 dB
a. [High Limit]	
b. Enter the number on the numeric keypad.	
c. [dB]	
3 Set the lower delta limit.	Delta Limit range: –150 to 100 dB
a. [Low Limit]	
b. Enter the number on the numeric keypad.	
c. [dB]	

To Set the Measurement Delta Sync Power Limits:

Step	Notes
1 On [Δ Sync Pwr Limits] select On or Off .	<p>Enables you to toggle the measurement limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> • If set to On, the delta sync. power metrics will change from blue to red (fail) or green (pass) and indicate either a “P” (pass) or “F” (fail). If the measured value exceeds the upper limit or lower limit, the words ‘ALL PASS’, in the bar at the bottom of the screen, will change to ‘FAILURE’. • If set to Off, the time delta sync. power value will be displayed in blue. If NO limits are set to On, the pass/fail bar will not be displayed at the bottom of the screen.
2 Set the upper delta limit. a. [High Limit] b. Enter the number on the numeric keypad. c. [dB]	Delta Limit range: –150 to 100 dB
2 Set the lower delta limit. a. [Low Limit] b. Enter the number on the numeric keypad. c. [dB]	Delta Limit range: –150 to 100 dB

Setting Up the Signal Generator

You can set up the signal generator while in the Spectrum Analyzer mode from the Setup menu. For more detailed information on the signal generator setup and operation, refer to “Using the Signal Generator” on page 200

CAUTION

The maximum power for the RF In and RF Out/SWR port is 20 dBm (100 mW). The maximum power for the Power Sensor port is 24 dBm (300 mW). When directly coupled to a base station, the test set can be damaged by excessive power applied to any of these three ports.

To prevent damage in most situations when you directly couple the test set to a base station, use the high power attenuator between the test set and the BTS.

NOTE

The lowest level the signal generator can go to is -90 dBm. In order to get a lower level, you must use an external attenuator. You can compensate for the attenuator in the RF Out Loss.

Step	Notes
1	[Setup]
2	[Sig Gen]
3	[Freq/Chan]
4	[Frequency] or [Channel]
5	Enter the channel or frequency using the numeric keypad.
6	<ul style="list-style-type: none">For channel select [Rev] or [Fwd]For frequency select [GHz], [MHz], [kHz], or [Hz],
7	[Mod Format]

Step	Notes	
8	Select the channel standard from the list using the up and down arrow buttons.	
9	[Select]	
10	Set the RF output amplitude a. [Amplitude] b. Enter the amplitude value using the numeric keypad. c. [dBm].	You may also enter a new value for amplitude by turning the rotary knob until the desired value is displayed or using the up and down arrow keys.
11	If you have previously stored RF Out Loss from an insertion loss measurement, go to the next step. Or Press [RF OUT Loss] to select On and enter the RF Out Loss value.	For information on the effects of the RF Out Loss function on the amplitude, refer to “Using the RF OUT Loss field,” below. Each time you press this softkey, the selected option changes.
12	Connect to the base station.	
13	On [Enable Sig Gen] select On .	Each time you press this softkey, the selected option changes.
14	On [RF] select On .	Each time you press this softkey, the selected option changes.

Using the RF OUT Loss field

The RF OUT Loss field is used when it is necessary to test the receiver sensitivity of a typical base station. The test set’s source will typically go down to –95 dBm. In order to reach –113 dBm for sensitivity testing, you must use an external pad. The measured value of the pad and connecting cables are entered into this field. This value is then used when this field is set to **On**. When this field is set to **On**, the test set will set the RF generator level to the correct level offset by the external pad/cabling. When you set the RF Generator to –113 dBm (with the RF OUT Loss

field turned **On** and the external pad/cabling loss value entered) the output at the end of the RF test cabling is -113 dBm.

Example: If you want to set the signal generator to -113 dBm, the pad and RF cabling measures 42.51 dB (measured with the 2 port insertion loss measurement screen prior to this test), the RF OUT Loss field is turned **On** (with the 42.51 dB loss value entered). The actual RF output of the signal generator is -70.49 dBm, the pad and RF cabling attenuated the signal to the desired level; so the RF signal at the end of the test cable/pad is -113 dBm. This also points out the importance of accurately measuring the loss of the pad and connecting cables.

Metrics Provided by the CDMA Tx Analyzer Measurement

This section contains descriptions of the individual CDMA transmit parameters in the metric display of the screen. The “Interpretation of CDMA Tx Analyzer Measurement Results” section contains expected result values and possible causes of error if the expected results are not met.

Frequency Error

Frequency error is the frequency difference between your transmitter's actual center frequency and the frequency (or channel) you entered.

PN Offset

The PN Offset is a “short code” sequence that provides a unique identifier for each sector of each cell site. The PN Offsets are applied to the I and Q signals before modulation. PN Offsets are offset in time by $52.08 \mu\text{s}$ and they repeat every 26.666 ms. This yields 512 unique short code sequences (0-511). The mobile phone needs the PN Offset to decode information in the Sync and Paging channels, which are transmitted by the base station.

Time Offset

The Time Offset compares the PN Offset timing with the overall system time. This measurement checks the start of the PN offset in comparison to either the GPS signal or the Even Second clock signal. For example, PN Offset 0 should repeat exactly on the rising edge of the Even Second clock. PN Offset 1 should repeat $52.08 \mu\text{s}$ after the rising edge of the Even Second clock, and so forth. Any error in time from that event is reported as a Time Offset.

Channel Power

Channel Power is the integrated power within a defined bandwidth. For CDMA the channel bandwidth is defined to be 1.25 MHz. Channel Power measures the power the base station is transmitting across the entire 1.25 MHz CDMA channel.

Estimated Rho

Estimated Rho is the measure of the modulation quality for a CDMA transmitter. This measurement is analogous to measuring FM accuracy and distortion in an AMPS network or EVM in a TDMA system. A Rho value of 1.0 is perfect,

indicating that all of the power is being transmitted correctly.

Carrier Feedthrough

Carrier Feedthrough is a result of the RF carrier signal feeding through the I/Q modulator and riding on the output circuitry without being modulated. Carrier Feedthrough is a common cause of bad Rho measurements.

Noise Floor

Noise Floor is the average power of all the inactive channels.

Pilot Power

Pilot Power is the total power in the Pilot code channel, expressed in dBm. The transmit power of the Pilot Channel signal for a given base station is normally constant.

Delta Page Power

Delta Page Power is the amplitude difference between the Paging Channel and Pilot Channel, expressed in dB. The transmit power of the Paging Channel is constant and can be set at a value relative to the Pilot Power. A common value is -4 dB relative to the Pilot.

Delta Sync Power

Delta Sync Power is the amplitude difference between the Sync Channel and Pilot Channel, expressed in dB. The transmit power of the Sync Channel is constant and may be set at a value relative to the Pilot Power. A common value is -10 dB relative to the Pilot.

Delta Quick Page Channel Power

Delta Quick Page Channel (QPCH) Power is the amplitude difference between the Quick Page Channel and Pilot Channel, expressed in dB. The QPCH is a bursted channel and is not on all the time. In order to capture the level of the QPCH, the statistic measures and holds the peak level of the QPCH. Until a QPCH has been measured, the value will be dashes. When “on”, the level of the QPCH is constant and is set at a value relative to the Pilot Power. The QPCH digital gain level can be set to 2, 1, 0, -1, -2, -3, -4, and -5 dB relative to the Pilot.

Interpretation of CDMA Tx Analyzer Measurement Results

This section contains expected result values and possible causes of error if the expected results are not met.

Frequency Error

The standards specify very tight Frequency Error performance. In the PCS bands, the 0.05 parts-per-million specification translates to only 99 Hz at a carrier frequency of 1980 MHz or 40 Hz at 850 MHz cellular frequencies. Frequency Error shows up as uncorrelated power that adds to the noise floor or shows up in other Walsh codes.

If a particular site loses its reference to GPS time, its reference signals will begin to drift over time. Phones already using the site can remain on the air because they derive their timing from the signals transmitted by the base station. However, phones using other sites/sectors may be prevented from using the site because they are confused by the error in frequency. This creates what is known as the “island cell effect”. By itself, the cell is still functional. To the rest of the system, it's inaccessible.

This island cell effect can be caused by a failure in the site's GPS receiver and timebase distribution network. Using the test set's Internal GPS receiver provides an independent time reference that will allow you to determine if this cell site is out of sync with the rest of the network (“island cell effect”).

PN Offset

Verify that the PN Offset is correct. If you are in Manual mode, the PN Offset will display the value you entered. Make sure the Time Offset is small (less than 3 μ s). If the Time Offset is greater than expected, see the section on Time Offset below. If you are in Auto mode, the test set will tune to the PN Offset with the smallest Time Offset. If an incorrect PN Offset is displayed, the Time Offset will likely be very large.

Time Offset

The CDMA standards specify a maximum offset of 10 μ s; generally 5 μ s is a recommended maximum. If the Time Offset is large enough, an “island cell” can occur. The “island cell effect” was mentioned already when discussing Frequency Error.

A phone moving outward toward the limit of its cell will need to acquire the adjacent cell in order to hand off. If the time offset of the target cell is too far from that of the current site, the handoff may not happen.

The dependence of the phone on correct system time limits the physical distance to a target cell's antenna. Each PN Offset is 52.08 μs ; if the propagation delay is too long, the received PN Offset may be different from the value designated on the Sync channel. This difference can confuse the phone, causing the handoff to fail.

Another cause of timing error is a bad GPS receiver or timing distribution network within the base station. To test your base station's GPS and timing distribution system, you can use the internal GPS receiver to generate an accurate timing reference for the test set to use while performing base station tests.

Channel Power

When making channel power measurements, make sure you have accounted for the loss of the test cable and high power attenuator you are using. If you do not know the loss of your test cable and high power attenuator configuration, perform an insertion loss measurement and enter the insertion loss as the RF In Loss value. For more information see [“Two Port Insertion Loss” on page 55](#).

If the channel power is lower than expected, verify you have a good connection to the RF output of the base station. Also, verify the cable you are using to connect to the base station is not faulty. A low channel power may also indicate a bad power amplifier.

Inaccurate channel power (high or low) may indicate an incorrect power setting at the base station.

Estimated Rho

The CDMA base station standard specifies that Rho must be greater than 0.912. Typical values for a healthy base station are greater than 0.94.

Rho failures can indicate problems in:

- Compression in linear amplifiers
- Magnitude and phase errors in the IQ modulator
- Phase non-linearity (group delay)
- Spurious signals in the transmission path
- Carrier feedthrough

Because the uncorrelated power appears as interference to the phones, poor Rho performance will affect the sector's capacity. The added interference can require that

the signal on traffic channels be raised to overcome the interference. This may, in turn, be seen as further interference. At some point, the site will have to shed calls in order to supply the remaining calls with enough signal versus the interference in the system.

Carrier Feedthrough

A good carrier feedthrough level is less than -25 dB. The IS-97 standard does not specify carrier feedthrough; however, this measurement provides an additional tool to troubleshoot the base station's transmitter.

In the frequency domain, carrier feedthrough can show up as an uncorrelated energy spike that can be seen on the spectrum analyzer by closely spanning into the top of the CDMA signal. The effects of carrier feedthrough can also show up as higher noise levels on the Code Domain Power screen. The inactive Walsh codes will be pushing the -27 dB specification for noise. Carrier feedthrough can be caused by the lack of isolation across the mixer and cavity of the transmitter's I/Q modulator. Shielding can help reduce carrier feedthrough.

Noise Floor

A good noise floor value is between -40 dB and -45 dB for modern base stations. If the noise floor is above these values (for example, -20 dB), the modulator may be the source of the added noise. Another possibility is a problem with the base station's channel card. The channel card generates the individual Walsh codes.

Pilot Power

If the measured value of pilot power is more than +/-0.5 dB different from the intended setting, it may indicate the following:

- There has been a change made to the digital gain setting of the pilot channel.
- The base station power amplifier has a problem.

Delta Page Power

If the measured value of Delta Page Power is more than +/-0.5 dB different from the intended setting, it may indicate that the digital gain setting for the Paging Channel has been changed.

Delta Sync Power

If the measured value of Delta Sync Power is more than +/- 0.5 dB different from the intended setting, it may indicate that the digital gain setting for the sync channel has been changed.

Delta Quick Page Channel Power

If the measured value of Delta QPCH Power is more than +/-0.5 dB different from the intended setting, it may indicate that the digital gain setting for the QPCH has been changed.

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- “Selecting a Reference” on page 330
- “RF Connections” on page 331
- “Preparing to Make W-CDMA Tx Analyzer Measurements” on page 332
- “Performing a Basic W-CDMA Transmitter Measurement” on page 333
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Using the W-CDMA Analyzer

W-CDMA transmitter measurements verify proper transmitter performance of a Base Station (commonly referred to as a Node B) and are typically made with the base station out-of-service in test mode. Non-intrusive measurements can also be made on a live network if a monitor or test port is present. This is usually a coupled port, and power levels are -20 or -30 dB down from the main Tx output power RF path which can exceed 10 Watts. Important metrics include:

- frequency error
- error vector magnitude (EVM)
- peak code domain error (PCDE)
- channel power
- carrier feedthrough
- code domain noise floor
- CPICH power
- delta powers between CPICH (Common Pilot Channel) and P-CCPCH (Primary Common Control Physical Channel), S-CCPCH (Secondary Common Control Physical Channel), PICH (Paging Indicator Channel), P-SCH (Primary Synchronization Channel) and S-SCH (Secondary Synchronization Channel).

These latter measurements are all performed in the “Code Domain” and are sometimes referred to as Code Domain Power (**CDP**) measurements.

One of the defining elements of a 3G system is high-speed data transmission. The 3GPP standard allows for multiple data rates depending on the application. This flexibility requires complex processing in both the transmitter and receiver to retain information quality and still transfer a variety of user information in the noisy spread spectrum environment. The CDP measurements allows you to quickly verify the operation of a 3GPP transmitter. In addition, it can give a high-level evaluation of modulation quality, channel power, and signal-to-noise in the code domain.

Selecting a Reference

The E7495A/B supports three different types of frequency reference input for making frequency measurements. These are listed in the table below.

E7495A/B Reference Inputs

Reference	Type of reference provided	Notes
GPS Ref	Time and Frequency	Highly recommended – provides accurate and network-independent measurements
Ext Ref	Frequency Only: 2.048 MHz, 10 MHz or 13 MHz	Recommended if no GPS signal is obtainable. Will only measure frequency and frequency error relative to BTS reference
Int Ref	Frequency Only: Uses the test set's internal oscillator	Only recommended if no other reference signal is available. You must typically be within 750 Hz of the base station operating frequency when entering frequency or channel information in order for the test set to be able to lock to the Tx signal.

It highly recommended that you use the Global Positioning System (GPS) signal as the frequency reference for the W-CDMA Tx measurement because it provides an independent reference for measuring the operating frequency of the base station. A GPS antenna must be connected to the GPS input of the test set, and the antenna must have a clear view of the sky in order for the GPS to lock. If a GPS signal cannot be obtained, you can use the frequency reference provided by the base station to perform the measurement. The E7495A/B supports 10 MHz and 13 MHz external references.

If you use the frequency reference provided by the base station, keep in mind that the frequency error metric will only be measuring the error relative to the base station reference signal, and not relative to absolute frequency and time. You will not be able to determine if the base station frequency is aligned with the other base stations in the network. Since the GPS provides an independent reference, the frequency error metric can be used to determine if the base station frequency is offset from the rest of the network.

RF Connections

For the RF connection, you can connect the E7495A/B RF Input Port either directly to the Tx RF output of the base station, or to the coupled output port on the base station when you are making W-CDMA transmitter measurements. In this way, the

W-CDMA Analyzer

Using the W-CDMA Analyzer

base station can remain on-air (in-service) while Tx measurements are being made. If the RF Input port of the instrument is connected directly to the Tx RF output, then the base station (or at least that sector) must be taken out of service.

CAUTION

The maximum power for the RF In and RF Out/SWR port is +20 dBm (100 mW). The maximum power for the Power Sensor port is +24 dBm (300 mW). When directly coupled to a base station, the test set can be damaged by excessive power applied to any of these three ports.

To prevent damage in most situations when you directly couple the test set to a base station, use the high power attenuator between the test set and the BTS.

NOTE

Most base stations also provide a coupled output, a test port for testing. This output port is usually in the form of a small RF connector on the front of the base station rack, located on or near the high power amplifier module, and is usually labeled “Test Out,” “Monitor Out,” or simply “Tx MON” or “TEST.” Be sure to check the specifications provided by the base station's manufacturer to determine the output power range of this test port prior to connecting the E7495A/B test set to avoid the possibility of damaging the test set.

Preparing to Make W-CDMA Tx Analyzer Measurements

The first step in measuring W-CDMA transmitter performance is to take the base station out of service. (In-service measurements are also possible if you use an external coupler or if a test port is available as described in the note above.) The next step is to choose the type of time reference available. The measurement configuration depends upon the type of time reference you choose to use. You can also use GPS to verify the frequency independently.

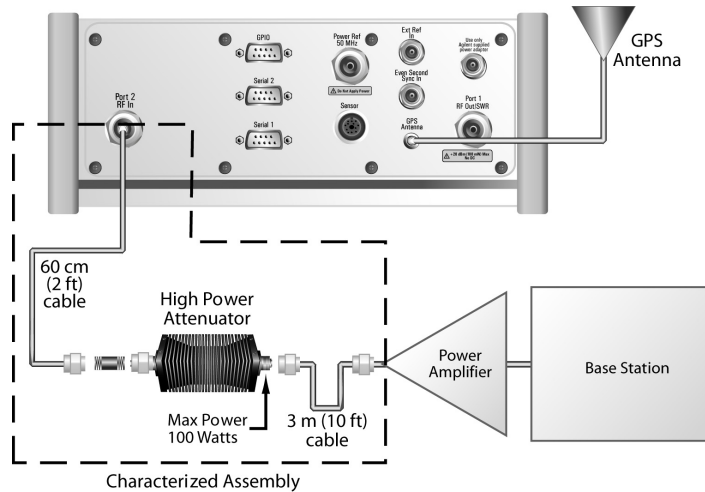
You must know the channel or carrier frequency of the transmitter to be analyzed. Additionally, each base station sector has a unique scrambling code that is transmitted to mobiles in that sector. These scrambling codes can be detected automatically by the test set or can be entered manually, if desired.

Performing a Basic W-CDMA Transmitter Measurement

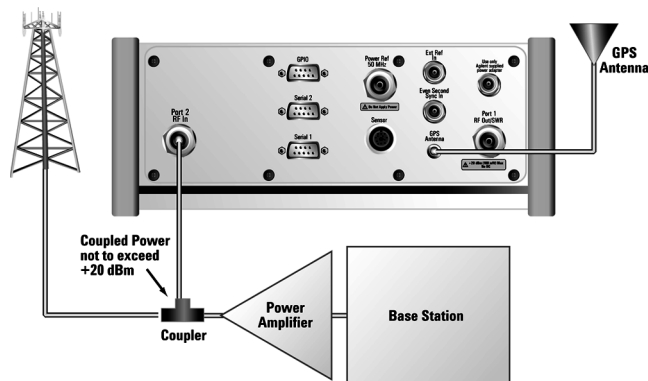
Step	Notes	
1	Mode	
2	[Tx Analyzer]	
3	[W-CDMA (UMTS) Analyzer]	
4	Setup the channel standard. <ol style="list-style-type: none"> a. [Chan Std] b. Highlight the channel standard you want using the up and down arrow buttons. c. [Select] 	
5	On [Units] select Freq or Chan . Select Chan for this example.	Each time you press this softkey, the selected option changes.
6	Setup the channel. <ol style="list-style-type: none"> a. [Channel] b. Enter the channel using the numeric keypad. c. [Fwd] or [Rev] 	
7	Setup the scrambling codes. <ol style="list-style-type: none"> a. [Scramble C...] b. [Auto] or [Manual] 	Each time you press this softkey, the selected option changes. Auto takes the strongest code. Manual lets you specify the scrambling code.
8	Setup the frequency/time reference. <ol style="list-style-type: none"> a. [Fr/Time Ref] b. [GPS] or [Internal Reference] or [External 10 MHz] or [External 13 MHz] 	GPS is the preferred frequency reference.
9	Connect to the base station.	

W-CDMA Analyzer Using the W-CDMA Analyzer

Step	Notes
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Connections for out of service W-CDMA measurements with GPS receiver as timing reference



Connections for in service W-CDMA measurements with GPS receiver as timing reference

NOTE

During a W-CDMA Analyzer measurement, a yellow triangle symbol may temporarily appear beside "GPS" in the lower right. The yellow triangle indicates

that the test set is re-synching with the GPS pulse per second. Once the test set is synched, a green dot appears in place of the triangle. If the GPS is unavailable, a red X appears. If this happens, you must choose another reference.

Multiple-View Display

The W-CDMA Tx analyzer multiple-view screen, Zoom view (default—[Figure 14-1 on page 336](#)) and 4 sections in the Full view ([Figure 14-2 on page 337](#)) as follows:

- The top-left graph (Full View) shows the power in all 512 channels (OVSFs or spread codes). The light blue section on the bottom bar corresponds with the section displayed in zoom view (described below). The red line across the graph represents the active channel threshold. The traffic channel displays in orange color, the rest are in the color shown in the control view.
- The top-right graph (Control View) shows the power in the control channels (see [Table 14-1](#)).
- The lower-left graph (Zoom View) shows the power in the section of the graph highlighted in light blue in the top-left graph, a section of 32, 64, or 128 codes.
- The bottom portion (Metrics View) displays the current measurement metrics.

NOTE

In W-CDMA, the PSCH and SSCH are not assigned spread codes and therefore do not appear in the code domain power display (Full View). The E7495A/B features a control channel graph view (Control View) for these two Sync channels to measure power only, since there is no spread code associated with these channels. They have special non-orthogonal scrambling codes and are only actually **On** 10% of the time

Table 14-1 Control Channels Acronyms

Acronym	Full Name	Viewable in Which Display Area
CPICH	Common Pilot Channel	Visible in all views (red bar)
PCCPCH	Primary Common Control Physical Channel	Visible in all views (yellow bar)
SCCPCH	Secondary Common Control Physical Channel	Visible in all views (green bar)
PICH	Paging Indicator Channel	Visible in all views (light blue bar)

Table 14-1 Control Channels Acronyms

Acronym	Full Name	Viewable in Which Display Area
PSCH	Primary Sync Channel	Visible ONLY in the Control View (blue bar)
SSCH	Secondary Sync Channel	Visible ONLY in the Control View (purple bar)

Figure 14-1 The Multiple-View Zoom Display



Figure 14-2

The Multiple-View Full Display



Setting the Display Options

The display options enable you to zoom in on portions of the graph, or to see the entire trace at once.

Step	Notes
1 [Display]	
2 On [View] select [Zoom] or [Full].	If you are displaying Zoom view and select Full view, the display changes the top-left and bottom-left graphs to show the first 256 codes in the top graph, and the second 256 codes in the bottom graph. If you select Zoom, two more options are available.

Step	Notes
3 [Position]	When you are in Zoom view, this option changes the starting point (spread code) of the section of the full view (upper graph) that the Zoom view (lower graph) will expand for more detailed analysis.
4 Enter the position using the numeric keypad.	
5 [Enter]	
6 On [Width] select [32], [64], or [128].	In Zoom view, smaller numbers selected with this option correspond to narrower zoom windows on the full view. If you select 32 for example, you will have the minimum window and maximum zoom. You will also see channel information displayed below each active channel. This information is the spreading factor used by that channel and its spread code or OVSF number.

Codogram Display

This view provides a history of the spectrum. You can use it to:

- see traffic channels as they come and go,
- track traffic channel call levels over time.

The W-CDMA Tx analyzer Codogram screen is divided into 3 sections in the Zoom view (default—[Figure 14-3 on page 339](#)) and 4 sections in the Full view ([Figure 14-4 on page 340](#)) as follows:

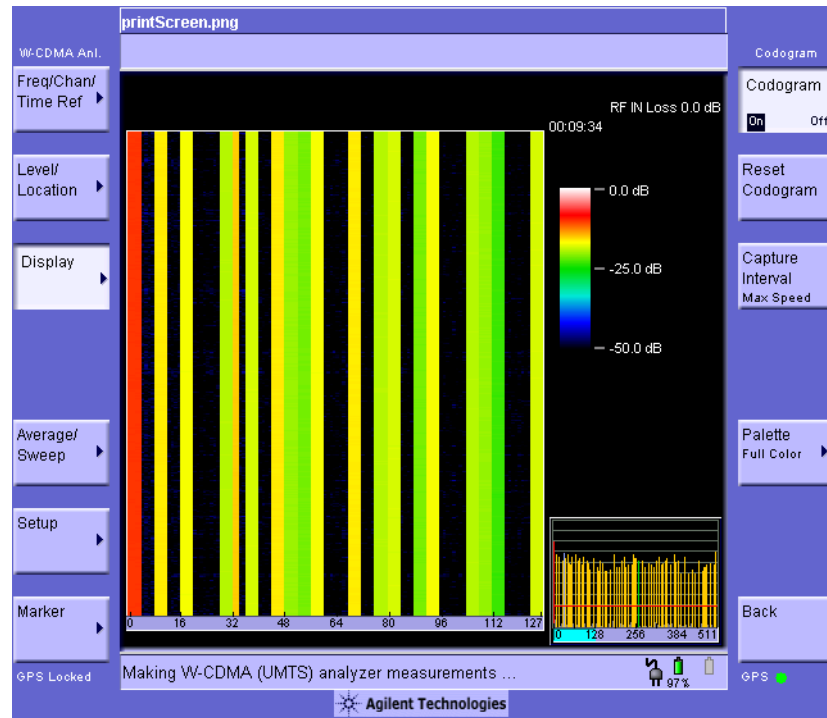
- **Zoom and Full views:** The lower-right graph (**Code Domain Trace view**) shows the power in all 512 OVSF (Orthogonal Variable rate Spread Factor) Code Channels. For display details, refer to “[Multiple-View Display](#)” on [page 335](#).
- **Zoom view:** The left graph (**Codogram view**) provides a display of data captured over time. The OVSF codes are shown on the x-axis and correspond to the light blue highlight on the Code Domain Trace view. You can change the time interval to allow longer spectrum history. The color corresponds to the

OVSF channel strength.

- **Full view:** The top-left graph (**Codogram view**) shows the power in the first half of the OVSF channels (SF512 channels 0 - 255). The lower-left graph shows the power in the other half of the channels (SF512 channels 256-511). Both graphs provide a display of data captured over time. You can change the time interval to allow longer spectrum history. The color corresponds to the OVSF channel strength.
- **Zoom and Full views:** The top-right graph (**Color Legend**) provides a color vs. power legend to help you interpret the power level in the Codogram.

Figure 14-3

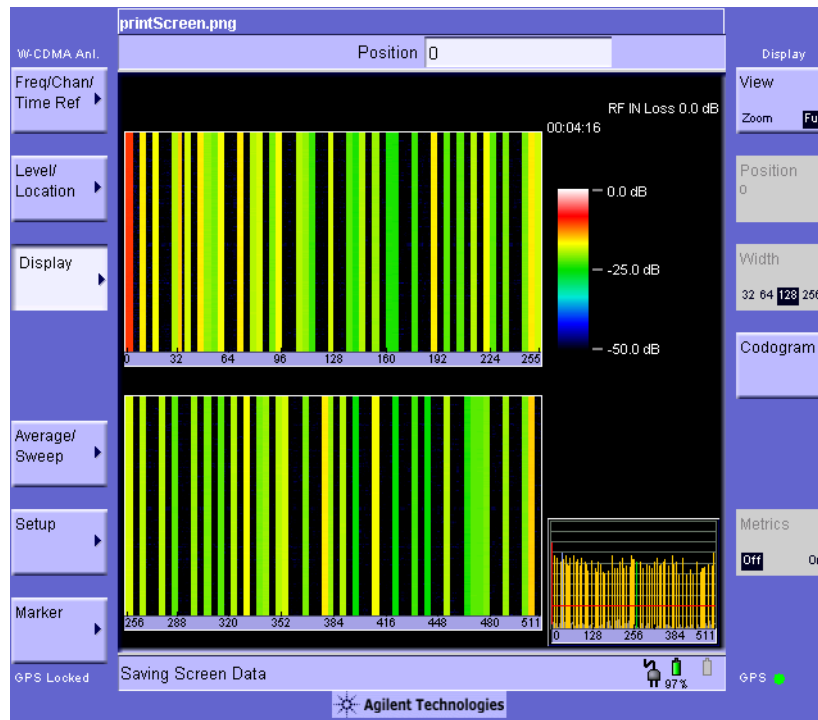
The Codogram Zoom Display



W-CDMA Analyzer

Figure 14-4

The Codogram Full Display



Setting Codogram Display Options

The display options enable you to zoom in on portions of the graph, or to see the entire trace at once.

Step	Notes
1 [Display]	
2 [Codogram]	
3 On [Codogram] select On or Off .	When you set [Codogram] to On, [Reset Codogram], [Capture Interval] and [Palette] become active.

Step	Notes
4 [Reset Codogram]	This restarts the data capture for the Codogram. You may see the screen freeze for a few seconds before the display starts plotting data again.
5 If desired set the capture interval:	Allows you to set the capture interval to 1 or more seconds. Or, you may set it to automatically determine the capture interval that provides the maximum data collection speed. If you need to return to the automatically determine capture speed, you must press a keypad key to access [Max Speed].
a. [Capture Interval]	
b. Enter the interval number using the numeric keypad.	
c. Select [sec] or [Max Speed].	
6 If desired set the display color:	The color/grayscale top and bottom mappings are determined by the Ref Level and Scale/Div settings. To change the mapping, go to [Level/Location] and change [Ref Level] and [Scale/Div].
a. [Palette]	
b. Select [Full Color] or [Grayscale].	

W-CDMA Analyzer Measurement Settings

Setting the Channel or Frequency Step

You can set the channel or frequency step so you can quickly increment to the next channel or frequency using the up and down arrow buttons.

Step	Notes
1 [Chan Step] or [Freq Step]	This choice depends on the [Units] mode you are using.
2 Enter the desired channel or frequency step using the numeric keypad.	
3 [Enter]	Notice (and verify) the number you entered below the Chan Step or Freq Step text on the corresponding button.

Setting the Scrambling Codes

The E7495A/B has two ways to identify the scrambling code being used by the transmitter under analysis: an automatic detection mode, **Auto**, and a manually-specified mode, **Manual**.

- In **Auto** mode, the test set automatically detects the scrambling code present in the signal.
- In **Manual** mode, the scrambling code can be entered by you instead of being auto-detected by the instrument.

If the scrambling code is known, its value can be entered and the test set can decode and display the code domain power of the signal, even if no P-SCH and S-SCH are present (a CPICH must be present, however). In normal operating conditions, these sync channels are available, so the P-SCH and S-SCH are used by the E7495A/B (and W-CDMA mobiles) to determine the correct sequence of scrambling codes

required to demodulate the DPCH channels.

Step	Notes
1 [Freq/Chan/Time Ref]	
2 [Scrambling C...]	
3 [Auto] or [Manual]	Each time you press this softkey, the selected option changes. In Manual mode, you can enter a number using the keypad.

Setting the W-CDMA Tx Analysis Display Reference Level

You can set the W-CDMA Tx analysis display to show the power in each channel as either relative power (dB) or absolute power (dBm). The test set's default display mode is relative. In relative mode, the top horizontal line (top-most graticule) of the display represents the total power (channel power) in the 3.84 MHz bandwidth of that W-CDMA signal being broadcast by the transmitter. It is always 0 dB in this mode since it is a relative measurement. The power in each channel is shown as a vertical bar, with its height expressed in dB relative to the total channel power.

If you set the reference level mode to absolute, then the top graticule in the display still corresponds to total channel power in the 5 MHz bandwidth. However, the reference level and all the power values of the vertical bars showing the power in each channel are now indicated with absolute power in dBm.

To set the W-CDMA transmitter reference level (while in W-CDMA Analyzer mode):

Step	Notes
1 [Level/Location]	
2 On [Reference] select Abs or Rel .	Each time you press this softkey, the selected option changes.

Compensating for the Loss of an External Cable and Attenuator

The insertion loss of the test cable and high power attenuator must be compensated for to obtain accurate W-CDMA power measurements, such as channel power. This process is called normalization and is described in [“Measuring Two Port Insertion](#)

[Loss](#)” on page 56. The insertion loss of the test cable/attenuator combination is accounted for as the RF In Loss, which is an offset applied to the power measurements by the test set.

Step	Notes
1 [RF IN Loss]	
2 Enter the RF In loss using the numeric keypad.	If you are using a cable and attenuator connected to the base station power amplifier, enter the combined cable and attenuator RF In loss here. The RF In loss can be obtained by measuring the Insertion loss. See “Two Port Insertion Loss” on page 55 .
	Note: If data had been previously entered in [RF IN Loss], that data will be lost and replaced by the value you enter here.
3 [dB]	

Setting Average, Sweep, and Restart

Setting the Sweep

You can select either continuous or single sweep. Continuous sweep provides repeated, ongoing measurements. Single sweep performs a single measurement that is repeated only when you push the Single button.

To set sweep:

Step	Notes
1 [Average/Sweep]	
2 [Continuous] or [Single]	Each time you press this softkey, the selected option changes.

Setting Averaging

You can choose to have averaging On or Off and to set the number of averages you want to take. Averaging only applies to the data, not the trace. When initialized, the Agilent E7495A/B defaults to running average:

- A running average computes the new result as the weighted sum of the last result and the new measurement. The last result is weighted by $(n - 1)/n$. The new result is weighted by $1/n$. Each new measurement produces a new result.

Averaging applies to the following measurement metrics and the control channel view only:

- Freq Error
- Noise Floor
- EVM
- PCDE
- Carrier Feedthrough
- Chan Pwr
- CPICH power
- all the delta powers

W-CDMA Analyzer

W-CDMA Analyzer Measurement Settings

- Control Channel Graph

To set averaging:

Step	Notes
1	Set the number of averages. <ol style="list-style-type: none">[Average]Enter the number of averages using the numeric keypad.[Enter]
2	Set averaging On or Off. <ol style="list-style-type: none">[Average/Sweep][Averaging][Off] or [On]

NOTE

These two steps can be performed in any order. However, if you turn averaging on and a large number of averages has previously been set, there may be a delay before you can change number of averages.

Setting Restart

When you have averaging turned **On** and you are in **Continuous** Sweep mode, you can restart the averaging by pressing the Restart menu key. The Restart key has no effect if you are in **Single** sweep mode.

To restart averaging:

Step	Notes
1	[Average/Sweep]
2	[Restart] This key is unavailable or has no effect when Sweep is set to Single . To restart a Single Sweep measurement, press [Single].

Setting the Active Channel Threshold Level and Auto Threshold Level

The active channel threshold level is an advanced setting that can be set to indicate which code channels are considered active. Any code channels exceeding this power level are considered active traffic channels and any code channels below this power level are considered inactive (or noise). A horizontal red line on the screen represents the threshold. The test set can set this level automatically, or you can manually enter a value.

In Auto mode the threshold level moves as the noise fluctuates. The threshold level is set by the test set at an optimal offset above the average noise floor. In Auto mode, you can alter the Auto Threshold Offset. The recommended and default setting is 0 dB. A negative value moves the threshold lower (closer to the noise floor) and is a more aggressive setting that increases the likelihood of interpreting an inactive channel as active. A positive value moves the threshold higher (away from the noise floor) and is a more conservative setting that increases the likelihood of interpreting an active channel as inactive.

In Manual mode the threshold level is fixed and does not move as the noise fluctuates.

To set the active channel threshold level:

Step	Notes
1 [Setup]	
2 On [Threshold] select Auto or Manual .	Each time you press this softkey, the selected option changes. If you choose Manual, you must enter the threshold you want using the numeric keypad, then press [dB].
3 [Auto Thres Offset]	The default value is 0 dB. Optionally, you can enter a negative (more aggressive) or positive (more conservative) value, then press [dB].

NOTE

Knowing which inactive code channels are contributing the most noise to the overall W-CDMA channel may provide clues to the source of noise, such as a bad channel card in the base station.

Enabling PICH and S-CCPCH

In 3GPP W-CDMA, two optional control channels are provided for: S-CCPCH and PICH. These can have different spreading codes and spreading factors. For this reason, the E7495A/B only identifies them as PICH and S-CCPCH channels when enabled by you. The test set defaults to the disabled (off) state. In the default mode, the test set still shows the energy by assuming a spread factor of 512 in the Full view and Zoom view graphs. Either the actual spreading factor or spreading code must be entered manually before the test set will display the PICH or S-CCPCH parameters with their correct spread factors and OVSF codes.

To enable the PICH and S-CCPCH

Step	Notes
1 [Setup]	The same procedure is used for both settings. S-CCPCH is used in this example.
2 [S-CCPCH]	Each time you press this softkey, the selected option changes.
3 On [S-CCPCH Enable], select [Off] or [On]	
4 [Spread Factor]	If you choose spread factor, you must press enter the spreading factor you want using the numeric keypad, then press [Enter].
5 [Channel]	If you choose channel, you must press enter the channel you want using the numeric keypad, then press [Enter].

Adding a Marker

Markers can be used on traces to help you visually track up to four signals. Each marker has the following settings:

- **Type:** Provides three options, including:
 - **Off**
 - **Normal**, which places a diamond-shaped, colored marker, along with a number, 1-4, on the trace.
 - **Delta**, is associated with a normal marker. Therefore, a normal marker must

exist prior to creating the delta marker. The delta marker displays the difference between the normal marker position and the delta marker position. Only one delta marker can be associated with a given normal marker. The normal marker must be active when Delta is selected.

- **Marker to Peak:** Places the active marker on the current greatest value of the trace.
- **Marker to Next Peak:** Places the active marker on the current second greatest value of the trace.

To add a marker to a trace

Step	Notes
1	[Marker]
2	[Marker]
3	[1], [2], [3], or [4]
4	[Type]
5	[Off], [Normal], or [Delta]
6	Locate the marker relative to the trace: <ul style="list-style-type: none">• [Marker to Peak]or• [Marker to Next Peak]

Metrics Provided by the W-CDMA Analyzer Measurement

This section contains descriptions of the individual W-CDMA transmitter metrics in the Metrics view of the screen. The [“Interpretation of W-CDMA Measurement Results” on page 352](#) section contains expected result values and possible causes of error if the expected results are not met.

Frequency

Frequency is the selected transmitter operating frequency entered by you (or calculated from the channel number entered by you).

Freq Error (Frequency Error)

Frequency error, as set up in Controls, is the frequency difference between your transmitter's actual center frequency and the frequency (or channel) you entered.

Scramble Code

The one being measured (manual or auto).

Noise Floor

Noise Floor is the average power level of all the inactive channels.

Threshold

Threshold is the active channel threshold level and is an advanced setting that can be set to indicate which code channels are considered active. (For more information, see [“Setting the Active Channel Threshold Level and Auto Threshold Level” on page 347.](#))

EVM (Error Vector Magnitude)

EVM is the measure of signal quality specified as a percent of noise to pure signal. It is the difference between the measured waveform and the theoretical modulated waveform (the error vector). EVM metrics are used to measure the modulation quality of a transmitter. The 3GPP standard requires the EVM not to exceed 17.5%.

PCDE (Peak Code Domain Error)

PCDE takes the noise and projects the maximum impact it will have on all OVSF

Metrics Provided by the W-CDMA Analyzer Measurement

codes. PCDE is the maximum value for the code domain error for all codes (both active and inactive).

In W-CDMA, specifically to address the possibility of uneven error power distribution, the EVM measurement has been supplemented with PCDE. The 3GPP standard requires the PCDE not to exceed -33 dB at a spreading factor of 256.

Carr Feedthru (Carrier Feedthrough)

Carrier Feedthrough is a result of the RF carrier signal feeding through the I/Q modulator and riding on the output circuitry without being modulated.

Chan Pwr (Channel Power)

Channel Power is the integrated power within a defined bandwidth. For W-CDMA the channel bandwidth is 3.84 MHz. Channel Power measures the power the base station is transmitting across the entire 3.84 MHz W-CDMA channel.

CPICH (Common Pilot Channel)

Common Pilot Channel (CPICH) is the channel that carries the scrambling code.

Control Channel Delta (Δ) Powers

The last column on the far right of the Metrics view shows the relative powers of the five control channels relative to the Common Pilot Channel. For example, P-CCPCH is the amplitude difference between the CPICH and the P-CCPCH. In W-CDMA systems, the transmit power of all the control channels can be set at different values relative to the CPICH. the five control channel Δ power metrics are:

- Δ P-CCPCH - primary common control physical channel
- Δ S-CCPCH - secondary common control physical channel
- Δ PICH - paging indicator channel
- Δ P-SCH - primary sync channel
- Δ S-SCH - secondary sync channel

Interpretation of W-CDMA Measurement Results

This section contains expected result values and possible causes of error if the expected results are not met.

Frequency

If you are in the channel mode, verify that the correct channelization and channel number are set.

Freq Error (Frequency Error)

The frequency error of the analyzer should be <1 kHz. If it is not, check to ensure that the test set is performing a correct measurement. You can do this by reviewing the frequency reference settings for the test set (refer to [“Selecting a Reference” on page 330](#)). Ensure that these settings are correct, and that the test set shows reference lock. Lastly, make sure the test set has been powered on, and has been locked for at least 15 minutes.

If the error is still occurring after performing the above procedures, you will need to check the Base Station equipment for a source of the error. You can also verify that the base station is malfunctioning by turning off its modulation hardware and performing a frequency measurement on the Base Station carrier signal in the spectrum analyzer mode of the test set (refer to [“Performing a Basic Spectrum Analyzer Measurement” on page 121](#)).

Scramble Code

If the Scramble code is not as expected, it could be due to an incorrect Base Station setting or to incorrect positioning of the test set. Use of the “strongest pilot” display to position the test set. If the correct Scrambling code cannot be located, check the base station settings.

Noise Floor

An unexpectedly high noise floor could be due to interfering signals.

Threshold

If the **Threshold** is not as expected, check the following:

Check the Threshold settings to make sure they are correct. (See [“Setting the Active Channel Threshold Level and Auto Threshold Level” on page 347](#) for more information.).

- If the Threshold setting is Auto with no offset, it is an indication that there is a poor signal to noise ratio.
- Check the Channel Power to ensure the level is as expected.
- If the power level is good, look for EVM and PCDE problems.

General Note:

For W-CDMA OA the Pilot Dominance and Multipath Power references are good, but for cabled up (W-CDMA Analyzer) they should be replaced with checks for transmitter's I/Q modulator and signal path. OA should also have references to them if Pilot Dominance and Multipath Power and Carrier Feedthrough are OK.

EVM (Error Vector Magnitude)

An unexpectedly high EVM could be due to interfering signals, carrier feedthrough, transmitter I/Q modulator, or signal path.

PCDE (Peak Code Domain Error)

An unexpectedly high PCDE could be due to interfering signals, carrier feedthrough, transmitter I/Q modulator, or signal path.

Carr Ft (Carrier Feedthrough)

A good Carrier Feedthrough level is less than -25 dB. The 3GPP standard does not specify Carrier Feedthrough; however, this measurement provides an additional tool to troubleshoot the base station's transmitter.

In the frequency domain, Carrier Feedthrough can show up as an energy spike that can be seen on the spectrum analyzer by closely spanning into the top of the W-CDMA signal. The effects of Carrier Feedthrough can also show up as higher noise levels on the Code Domain Power screen. Carrier Feedthrough can be caused by the lack of isolation across the mixer and cavity of the transmitter's I/Q modulator.

Chan Pwr (Channel Power)

If the Channel Power level is not as expected, check pilot dominance and the number of Scramble codes visible. All visible sectors will contribute to channel power. Also, check Amplifier Capacity and Utilization, they could have exceeded the maximum capacity. A high power data call could be indicated by a very wide and tall bar.

CPICH (Common Pilot Channel)

Interpretation of W-CDMA Measurement Results

CPICH will vary with distance from the base station and clear line of sight to the antenna. If the CPICH is not as expected, check pilot dominance and base station settings (ratio to other control channels should be good).

Control Channel Delta (Δ) Powers

The Delta results should match the Base Station settings. If not, ensure the Base Station settings are as expected.

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- “Common 1xEVDO Tx Analyzer Measurements” on page 357
- “Preparing to Make 1xEVDO Tx Analyzer Measurements” on page 357
- “Performing a Basic 1xEVDO Transmitter Measurement” on page 358
- “Interpreting the Display” on page 358
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- “Setting the Frequency/Time Reference” on page 363
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- “Setting Measurement Time” on page 367
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- “Metrics Provided by the 1xEV-DO Tx Analyzer Measurement” on page 384
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- “Customizing Your Display” on page 393
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1xEV-DO Analyzer

“Colors Used on the MAC Code Domain CDP Display” on page 394

“Colors Used on the Pilot Code Domain CDP Display” on page 395

“Displaying the Codogram” on page 395

“Codogram Settings” on page 396

Using the 1xEV-DO Analyzer

1xEV-DO transmitter measurements verify proper transmitter performance and are typically made with the access network (AN) still in service. The Access Network only needs to be taken out of service when you are setting or measuring the Tx Power Out level, and this is typically only performed during Preventative Maintenance. Important metrics include:

- Frequency Error
- PN and Time Offsets
- Channel Power
- Idle On/Off Ratio
- Pilot + MAC power
- Pilot Rho (estimated)
- MAC Rho (estimated)

CAUTION

The maximum power for the RF In and RF Out/SWR port is 20 dBm (100 mW). The maximum power for the Power Sensor port is 24 dBm (300 mW). When directly coupled to an access network, the test set can be damaged by excessive power applied to any of these three ports.

To prevent damage in most situations when you directly couple the test set to an access network, use the high power attenuator between the test set and the BTS.

Common 1xEVDO Tx Analyzer Measurements

Preparing to Make 1xEVDO Tx Analyzer Measurements

When measuring 1xEVDO transmitter performance, there is no need to take the access network out of service. The Access Network only needs to be taken out of service when you are setting or measuring the Tx Power Out level, and this is typically only performed during Preventative Maintenance.

The first step is to choose the type of time reference available. The measurement configuration depends upon the type of time reference you choose to use. Optimally, a GPS time reference is desired. GPS provides an independent time reference that can help determine if the access network under test is synchronized with the rest of the network. Access networks not synchronized with the rest of the network are referred to as “island cells”.

1xEV-DO Analyzer

Using the 1xEV-DO Analyzer

NOTE

If a **GPS** time reference is available, you will be able to see all the metrics, and you will be able to verify that the access network has correctly locked onto the GPS signal.

If you connect to the access network's **Even Second Clock**, you will still get all the metrics, but you will not have an independent check that the access network has locked onto the GPS signal.

You need a timing reference (either GPS or ESC) to see PN Offset and Time Offset results. When using another non-time based reference (for example, **Internal Reference**), results for **PN Offset** or for **Time Offset** will be unavailable.

You must also know the channel or frequency of the 1xEVDO signal to be analyzed.

Each access network sector is assigned a unique PN [pseudo-noise] Offset. If you are using a GPS signal or the Even Second Clock, the PN Offset will be detected for you. If you are making measurements without the aid of either a GPS signal or the Even Second Clock, you will need to know the PN Offset of the Access Network that is producing the signal to be analyzed. For more information on PN Offsets refer to [“Adding a Marker” on page 371](#).

Performing a Basic 1xEVDO Transmitter Measurement

NOTE

Once you have taken the access network out of service (this is necessary, for example, when you are setting the Tx Power Out level) and you have made the proper connections, you can perform 1xEVDO transmitter measurements.

NOTE

Using GPS Time Reference signals: During a 1xEVDO Analyzer measurement, a yellow triangle symbol may temporarily appear beside “GPS” in the lower right. The yellow triangle indicates that the test set is re-synching with the GPS even second pulse. Once the test set is synchronized, a green dot appears in place of the triangle. If the GPS is unavailable, a red X appears.

A red X will also appear beside “GPS” at the bottom right if you are using the Even Second Clock timing reference but have not set the instrument to use the Even Second Clock. If this is happening, press **Fr/Time Ref** and select **External Even Second** as your timing reference.

Interpreting the Display

The 1xEVDO Tx Analyzer screen is divided into two sections:

- The CDP (Code Domain Power) display - this is the graphic bar chart taking up most of the screen
- The metrics display - this is a table of values at the bottom of the screen

In the CDP display either 64 (the default setting) or 128 Walsh codes are shown in Hadamard order. These represent active MAC (Media Access Control) channels being broadcast from the AN (Access Network). The bars represent combined I and Q code power for each active MAC channel number.

The Y-axis labels display the relative power (dB) or absolute power (dBm), threshold level, and dB/division. When the Y-axis is set to display relative power, it is important to know which CDP Type you have set. Press Setup, then CDP Type to find or set this. If your CDP Type is either MAC 64 or MAC 128, the CDP plot values are displayed in dB, relative to the total signal power contained within the MAC time regions of the signal. On the other hand, if your CDP Type is set to Pilot, the CDP plot values are displayed in dB, relative to the total signal power contained within the Pilot time regions of the signal.

The X-axis labels display active channel numbers. Active code channels shown on the display include:

- Active MAC (Medium Access Control) RPC (Reverse Power Control) channels (shown in orange)
- RA (Reverse Activity) MAC channel (shown in light blue)
- Noise (shown in light gray)
- Unknown (MAC indexes 0 to 3 only) (shown in light brown)
- Pilot (shown as a red bar, and only when CDP Type is Pilot)

The *metrics display* shows 14 measurement parameters displayed below the CDP display in three columns and five rows—each with a value and units. For more information about the parameters in the metric display, refer to “[Metrics Provided by the 1xEV-DO Tx Analyzer Measurement](#)” on page 384.

The time reference indicator is at the bottom right. For each indicator the text indicates which time reference you have chosen. A green LED indicates a locked condition, a red “X” indicates an unlocked condition.

Optional 1xEV-DO Tx Analyzer Measurement Settings

You can change several optional measurement parameters in the 1xEV-DO Tx Analyzer:

- “Setting the Channel or Frequency Step” on page 360
- “Setting the PN Offset” on page 362
- “Setting the PN Increment” on page 362
- “Setting the Frequency/Time Reference” on page 363
- “Setting Units” on page 364
- “Setting the 1xEV-DO Transmitter Reference Level” on page 364
- “Setting the Active Channel Threshold Level and Auto Threshold Level” on page 366
- “Setting Measurement Time” on page 367
- “Setting Measurement Offset” on page 367
- “Setting the Slot Threshold Level” on page 368
- “Setting the CDP Type” on page 368
- “Setting Average, Sweep, and Restart” on page 369
- “Adding a Marker” on page 371
- “Setting the Pass/Fail Limits” on page 373

Setting the Channel or Frequency Step

You can set the channel or frequency step so you can quickly increment to the next channel or frequency using the up and down arrow buttons.

Step	Notes
1. [Chan Step] or [Freq Step]	This choice depends on the [Units] mode you are using.

Step	Notes
2. Enter the desired channel or frequency step using the numeric keypad.	
3. [Enter]	Notice (and verify) that the number you entered (the channel step number or the frequency step number) appears below the Chan Step or Freq Step text on the corresponding button.

Setting the PN Offset

The PN Offset (Pseudo-Noise Offset) key allows you to set the analyzer to find the PN Offset automatically, or to set it manually to a known value.

The PN Offset is an offset into a short code sequence that provides a unique identifier for each sector of each cell site. There are 512 unique offsets (0 - 511), which the access terminals use to decode the information broadcast by the access network.

Step	Notes
1. [PN Offset]	Each time you press this key, the setting toggles between Auto and Manual .
2. If you are setting the PN Offset manually, enter the PN Offset number using the numeric keypad.	Anyvalue from 0 to 511 is valid.
3. If you are setting the PN Offset manually, press [Enter]	Notice (and verify) that the number you entered for your chosen PN Offset number appears below the PN Offset text on the corresponding button. Note that no number is displayed if the setting is Auto .

Setting the PN Increment

The PN Increment allows you to choose the increment step for the PN Offset search when PN Offset is set to **Auto**. Typically the PN Increment is set to 1 when measuring 1xEV-DO transmitter performance while connected to the access network via RF cable.

The PN Increment field enables you to search based on a step size of your choice. If PN Increment = 1 (default), the search will step through PN values by one PN at a time. If PN Increment = 5, it will step through PN values 0, 5, 10, and so on. The Measured PN displayed will be a multiple of 5, even if the actual PN is not a multiple of 5. If you know that all access networks in the area have fixed increments, then set the PN Increment field to that increment value. If you don't know, then use the default value of 1.

Step	Notes
1. [PN Inc]	
2. Enter the PN Increment using the numeric keypad.	The maximum value you can enter is 15.
3. [Enter]	Notice (and verify) that the number you entered for your chosen PN Increment number appears below the PN Inc text on the corresponding button.

Setting the Frequency/Time Reference

This key is used to specify the source of your frequency reference, or your frequency and time reference. The analyzer needs an accurate reference signal in order to make accurate measurements, and this is where you specify the source of this reference signal.

Step	Notes
1. [Fr/Time Ref]	The frequency/time reference form is displayed

Step	Notes
2. Select the frequency and time reference from the list using the up and down arrow buttons.	<p>If the sky (and hence the satellites) is visible from the position of your analyzer, you can select GPS to get frequency and timing references from the GPS signal. The GPS antenna will need to be attached to the analyzer.</p> <p>If you connect to the access network's Even Second Clock, you will still get all the metrics, but you will not have an independent check that the access network has locked onto the GPS signal.</p> <p>Other options available are Internal Reference, External 10 MHz, and External 19.6608 MHz. These last three options only provide a frequency reference. They do not provide a time reference. If you use a pure frequency reference, you will not be able to see results for PN Offset or for Time Offset.</p>
3. [Select]	

Setting Units

This key is used to toggle between **Frequency** and **Channel** for your measurements. That is, you can decide whether to specify (and measure) the frequency in Hertz, or to specify the Channel Number.

Step	Notes
1. [Units]	Each time you press this key, you toggle between Freq (measurements in Hertz) and Chan (measurements by Channel Number).

Setting the 1xEV-DO Transmitter Reference Level

You can set the 1xEV-DO transmitter reference level to display either relative power

Optional 1xEV-DO Tx Analyzer Measurement Settings

(dB) or absolute power (dBm). The test set defaults to relative. The top graticule (horizontal line) represents the total power in the 1xEV-DO channel. The scale per division is set to 5 dB per division by default, but you can change it if you wish.

If the reference level is set to relative, the reference level represents the total power in the 1xEV-DO channel, and is displayed as 0.0 dB. If the reference level is set to absolute, the reference level displays the actual power (in dBm) for the particular time domain section relevant to the selected CDP type. For example, in pilot CDP mode, the absolute power level is measured only over the pilot burst region of the signal.

To Set the 1xEV-DO Transmitter Reference Level:

Step	Notes
1. [Level]	
2. On [Reference] select Abs or Rel .	Each time you press this softkey, the selected option changes.
3. [RF IN Loss]	
4. Enter the RF In Loss using the numeric keypad.	If you are using a cable and attenuator connected to the access network power amplifier, enter the combined cable and attenuator loss here. The RF In Loss can be obtained by measuring the Insertion Loss. See “Two Port Insertion Loss” on page 55 . Note: If data had been previously entered in [RF IN Loss], that data will be lost and replaced by the value you enter here.
5. [dB]	

NOTE

The insertion loss of the test cable and high power attenuator must be accounted for to obtain accurate 1xEV-DO power measurements such as Pilot+MAC power. The insertion loss of the test cable/attenuator combination is accounted for as the RF In Loss, which is an offset applied by the test set to the power measurements.

Setting the Active Channel Threshold Level and Auto Threshold Level

The active channel threshold level is an advanced setting that can be set to help indicate which code channels are considered active. A horizontal red line on the screen represents the threshold level. The test set can set this level automatically, or you can manually enter a value. Any code channels below this power level are automatically considered to be inactive channels (or noise), regardless of any other considerations.

Any code channels above this power level are considered to be *possibly, but not necessarily*, active. It is possible that inactive channels with a high noise level could exceed the Active Channel Threshold Level despite not being active, so a further test is performed to check if this is happening. For a channel to be considered as active, it must not only exceed the threshold level, but it must *also have a low code power:time variance*.

In Auto mode, the threshold level moves as the noise fluctuates. The threshold level is set by the test set at an optimal offset above the average noise floor. In Auto mode, you can alter the Auto Threshold Offset, which sets the threshold level above or below the calculated optimal level. The recommended and default setting is 0 dB, which represents setting the threshold level at the calculated optimum level. A negative value moves the threshold lower (closer to the noise floor) and is a more aggressive setting that increases the likelihood of interpreting an inactive channel as active. A positive value moves the threshold higher (away from the noise floor) and is a more conservative setting that increases the likelihood of interpreting an active channel as inactive.

In Manual mode the threshold level is fixed and does not move as the noise fluctuates.

To Set the Active Channel Threshold Level:

Step	Notes
1. [Setup]	
2. On [Thresh Lvl] select Auto or Manual .	Each time you press this softkey, the selected option changes. If you choose Manual, you must enter the threshold you want using the numeric keypad, then press [dB].
3. [dB]	

Step	Notes
4. [Auto Thres Offset]	The default value is 0 dB. Optionally, you can enter a negative (more aggressive) or positive (more conservative) value in dB.
5. [dB]	

Setting Measurement Time

The measurement time setting allows you to alter the speed at which measurements are made. Three choices exist: Slow, Medium, and Fast. The test set defaults to Medium. Slow measurement time provides a more repeatable measurement at the expense of time, and is done by increasing the number of slots that are measured. Fast measurement time provides a quicker measurement at the expense of repeatability, and is done by decreasing the number of slots that are measured. Medium measurement time strikes a balance between measurement speed and repeatability.

Meas Time Setting	CDP & Rho Measurement Interval	Data Channel Modulation Measurement Interval	RF Metric Measurement Interval
Fast	3 full slots	3 full slots	16 full slots
Med	6 full slots	6 full slots	32 full slots
Slow	9 full slots	9 full slots	48 full slots

To Set the Measurement Time:

Step	Notes
1. [Setup]	
2. On [Meas Time] select Slow , Med , or Fast .	Each time you press this softkey, the selected option changes.

Setting Measurement Offset

The Measurement Offset setting determines the start of the measurement interval

relative to the start of the pilot sequence frame, that is, relative to the start of PN 0. You can use the Measurement Offset parameter in conjunction with the Meas Time parameter to view a specific part of the frame.

To Set the Measurement Offset:

Step	Notes
1. [Setup]	
2. Enter the Measurement Offset using the numeric keypad.	The maximum value you can enter is 15.

Setting the Slot Threshold Level

The Slot Threshold is a level, measured relative to the idle power, that determines whether a slot is idle or non-idle. When the power in a slot is greater than the Slot Threshold, that slot is determined to be non-idle. When the power in the slot is less than, or equal to, the Slot Threshold level, the slot is determined to be idle.

To Set the Slot Threshold Level:

Step	Notes
1. [Setup]	
2. Press [Slot Thresh] and enter the threshold value using the numeric keypad, the rotary knob, or the up and down arrows.	Specify the Slot Threshold level in dB. The minimum setting is -100 dB, and the maximum setting is 0 dB.
3. [dB]	

Setting the CDP Type

The CDP Type parameter is used to specify whether you are despreding Pilot, MAC 64, or MAC 128 codes when you are performing your measurement.

NOTE

Rev 0 of the 3GPP2 (Third Generation Partnership Project 2) standards requires 64 MAC codes to be despread; Rev A requires that 128 MAC codes are despread.

To Set the CDP Type:

Step	Notes
1. [Setup]	
2. Press [CDP Type].	
3. Press the correct CDP Type key.	There are three CDP Type options available to you. These are Pilot, MAC 64, and MAC 128

Setting Average, Sweep, and Restart

Setting the Sweep

You can select either continuous or single sweep. Continuous sweep provides repeated, ongoing measurements. Single sweep performs a single measurement that is repeated only when you push the Single button.

To set sweep:

Step	Notes
1 [Average/Sweep]	
2 [Continuous] or [Single]	Each time you press one of these softkeys, the other softkey is automatically inactivated.

Setting Averaging

You can choose to have averaging On or Off, and to set the number of averages you want to take. When initialized, the Agilent E7495A/B defaults to running average:

- A running average computes the new result as the weighted sum of the last result and the new measurement. The last result is weighted by $(n - 1)/n$. The new result is weighted by $1/n$. Each new measurement produces a new result.

The reported averages for the following measurements will only be updated when idle slots are identified within the capture interval. If no idle slots are identified, the average values reported will be from the previous capture interval:

- Idle Power
- On/Off Ratio

- Noise Floor

The reported averages for the following measurements will only be updated when non-idle slots are identified within the capture interval. If no non-idle slots are identified, the average values reported will be from the previous capture interval:

- Non-idle Power

NOTE

The Idle Slots metric itself is always averaged even if averaging is switched **Off**. It represents the average of all the captures since the measurement was started. You can reset the Idle Slots metric by changing a parameter, or by using the **Restart** key.

When you switch averaging **On**, it is averaged in the same way as the other metrics.

To set averaging:

Step	Notes
1	Set the number of averages. <ol style="list-style-type: none"> [Average] Enter the number of averages using the numeric keypad. [Enter]
2	Set averaging On or Off. <ol style="list-style-type: none"> [Average/Sweep] [Averaging] [Off] or [On]

NOTE

These two steps can be performed in any order. However, if you turn averaging on and a large number of averages has previously been set, there may be a delay before you can change number of averages.

Using Restart

When you have averaging turned on, you can restart the averaging by pressing the Restart menu key. This restarts the averaging for running average in either Continuous or Single sweep mode.

To restart averaging:

Step	Notes
1 [Average/Sweep]	
2 [Restart]	<p>This key is unavailable or has no effect when Sweep is set to Single. To restart a Single Sweep measurement, press [Single].</p> <p>It is worth noting that there are some other events that automatically cause a restart. These events are:</p> <ul style="list-style-type: none"> • If the analyzer identifies a change in PN Offset. • If you enter a new PN Offset value. • If the PN Offset State is changed to Auto or to Manual. • If you change the X-scale from MAC to Walsh Code, or from Walsh Code to MAC. • If you change the Measurement Time. • If you change the CDP Type.

Adding a Marker

Markers can be used on the CDP display to help you visually track up to four signals. Each marker has the following settings:

- **Type:** Provides three options, including:
 - **Off**
 - **Normal**, which places a diamond-shaped, colored marker, along with a number, 1-4, on the CDP display.
 - **Delta**, is associated with a normal marker. Therefore, a normal marker must exist prior to creating the delta marker. The delta marker displays the difference between the normal marker position and the delta marker position. Only one delta marker can be associated with a given normal marker. The normal marker must be active when Delta is selected.

Optional 1xEV-DO Tx Analyzer Measurement Settings

- **Marker to Peak:** Places the active marker on the current greatest value of the CDP display.
- **Marker to Next Peak:** Places the active marker on the current second greatest value of the CDP display.

Step	Notes
1 [Marker]	
2 [Marker]	
3 [1], [2], [3], or [4]	
4 [Type]	
5 [Off], [Normal], or [Delta]	
6 Locate the marker relative to the code domain plots:	<ul style="list-style-type: none"> • [Marker to Peak] or • [Marker to Next Peak]

Setting the Pass/Fail Limits

The measurement limits settings enable you to alter the values of the test limits for the important measurements on the 1xEV-DO Tx Analyzer Screen. These settings affect the metrics color display: red represents fail, green represents pass. Next to the displayed measurement value, a (P) for Pass, or (F) for Fail, will be shown to further indicate whether the value is within or outside the set limits. In addition, the words “ALL PASS” or “FAILURE” are displayed in the bar at the bottom of the screen for all limits which have been turned on. To reduce display clutter with all the available limit lines, the limit lines will not be displayed for this screen.

- **Frequency Error Limits:** Sets the high and low Frequency Error limits for the channel. Any measured frequency error that is outside of the set limits will result in a failure indication. The High limit is set by entering a positive number, and the Low limit is set by entering a negative number.
- **Time Offset Limits:** Sets the high and low time offset limits for the channel. Limits are set in microseconds. Any measured time offset value that is outside of the set limits will result in a failure indication.
- **On/Off Ratio Limits:** This refers to the Idle On/Off Power Ratio, which is ratio of the Idle Power to the Noise Floor. The result is blanked out when none of the acquisition slots are idle, that is, when Idle Slots shows 0%. The number of slots over which the acquisition is made is determined by the Capture Interval, which itself is determined by the Meas Time setting.
- **Estimated Pilot Rho Limits:** Sets the lower limit for Pilot Rho (the upper limit is always 1.0, representing a perfect signal), and switches the Estimated Pilot Rho Limits On or Off. Any measured, estimated rho value that falls below the lower limit will result in a failure indication.

Pilot Rho is the measure of the modulation quality for a 1xEV-DO transmitter. A Rho value of 1.0 represents a perfect signal, indicating that all the power is being transmitted correctly. Estimated Pilot Rho is only measured over the 96 pilot chips contained within every half-slot.

- **Estimated MAC Rho Limits:** Sets the lower limit for MAC Rho (the upper limit is always 1.0, representing a perfect signal), and switches the Estimated Pilot Rho Limits On or Off. Any measured, estimated rho value that falls below the lower limit will result in a failure indication.

MAC Rho is the measure of the modulation quality for a 1xEV-DO transmitter. A Rho value of 1.0 represents a perfect signal, indicating that all the power is being transmitted correctly. Estimated MAC Rho is only measured over the 128 MAC chips contained within every half-slot.

Optional 1xEV-DO Tx Analyzer Measurement Settings

- **Max Inactive Ch Limits:** This sets the lower inactive channel power limits for MAC channels when you are testing CDP Type MAC 64 or CDP Type MAC 128, and for the Pilot channel when you are testing CDP Type Pilot.

If you have set **Max Inactive Ch Limits** to be **Off**, the maximum inactive channel power is reported on the front panel with no indication of whether this is a good or a bad result. If you have set **Max Inactive Ch Limits** to be **On**, the measured inactive channel power level is tested against the Low MAC Limit or the Low Pilot Limit (depending on your specified CDP Type), and either “F” (for a fail, or a “P” (for a pass) is also displayed against the measurement.

To Set the Measurement Frequency Error Limits:

Step	Notes
1 [Setup]	
2 [Limits]	
3 On [Freq Error Limits] select On or Off .	<p>Enables you to toggle the measurement limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> • If set to On, the Frequency Error will change from black to red (fail), or to green (pass), and will indicate either a “P” (pass) or “F” (fail). If the measured value exceeds either the upper limit or the lower limit, the words ‘ALL PASS’ in the bar at the bottom of the screen will change to ‘FAILURE’. • If set to Off, the channel freq/number value will be displayed in blue. The bar at the bottom of the screen will indicate measurement in progress.
4 Set the upper limit.	
a. [High Limit]	
b. Enter the number on the numeric keypad.	
c. [GHz], [MHz], [kHz], or [Hz]	
5 Set the lower limit.	
a. [Low Limit]	
b. Enter the number on the numeric keypad.	
c. [GHz], [MHz], [kHz], or [Hz]	

To Set the Measurement Time Offset Limits:

Step	Notes
1 On [Time Offset Limits] select On or Off .	<p>Enables you to toggle the measurement limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> <li>• If set to On, the displayed time offset metrics will change from blue to red (fail), or to green (pass), and will indicate either a “P” (pass) or “F” (fail). If the measured values exceed the upper limit or falls below the the lower limit, the words ‘ALL PASS’ in the bar at the bottom of the screen will change to ‘FAILURE’. <li>• If set to Off, the time offset value will be displayed in blue. The bar at the bottom of the screen will indicate measurement in progress.
2 Set the upper limit.	
a. [High Limit]	
b. Enter the number on the numeric keypad.	
c. [μ sec]	
3 Set the lower limit.	
a. [Low Limit]	
b. Enter the number on the numeric keypad.	
c. [μ sec]	

To Set the Idle On/Off Ratio Limits:

Step	Notes
1 Press [On/Off Ratio Limits].	.
2 Press [Limits].	<p>Enables you to toggle the Idle On/Off Ratio Limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> • If set to On, the displayed On/Off Ratio metric will change from blue to red (fail), or to green (pass), and will indicate either a “P” (pass) or “F” (fail). If the measured value exceeds the lower limit, the words ‘ALL PASS’ in the bar at the bottom of the screen will change to ‘FAILURE’. • If set to Off, the Idle Power and Non Idle Power values will be displayed in blue. The bar at the bottom of the screen will indicate measurement in progress.
3 Set the lower limit. a. [Low Limit] b. Enter the number on the numeric keypad. c. [Enter]	Lower Limit range: –200 to 200 dB

To Set the Estimated Pilot Rho Lower Limit:

Step	Notes
1 Press [Pilot Rho Limit].	.
2 Press [Limits].	<p>Enables you to toggle the Estimated Pilot Rho measurement's lower limit function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> • If set to On, the displayed Estimated Pilot Rho metrics will change from blue to red (fail), or to green (pass), and will indicate either a "P" (pass) or "F" (fail). If the measured value falls below the lower limit, the words 'ALL PASS' in the bar at the bottom of the screen will change to 'FAILURE'. • If set to Off, the Estimated Pilot Rho value will be displayed in blue. The bar at the bottom of the screen will indicate measurement in progress.
3 Set the lower limit.	Lower Limit range: 0 to 1
a. [Low Limit]	
b. Enter the number on the numeric keypad.	
c. [Enter]	

To Set the Estimated MAC Rho Lower Limit:

Step	Notes
1 Press [Est MAC Rho Limit].	.
2 Press [Limits].	<p>Enables you to toggle the Estimated MAC Rho measurement's lower limit function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> • If set to On, the displayed Estimated MAC Rho metrics will change from blue to red (fail), or to green (pass), and will indicate either a "P" (pass) or "F" (fail). If the measured value falls below the lower limit, the words 'ALL PASS' in the bar at the bottom of the screen will change to 'FAILURE'. • If set to Off, the Estimated MAC Rho value will be displayed in blue. The bar at the bottom of the screen will indicate measurement in progress.
3 Set the lower limit. a. [Low Limit] b. Enter the number on the numeric keypad. c. [Enter]	Lower Limit range: 0 to 1

To Set the Maximum Inactive Channel Lower Limit:

Step	Notes
1 Press [Max Inactive Ch Limit].	
2 Press [Limits].	<p>Enables you to toggle the Maximum Inactive Channel measurement's lower limit function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> • If set to On, the displayed Maximum Inactive Channel metrics will change from blue to red (fail), or to green (pass), and will indicate either a "P" (pass) or "F" (fail). If the measured value falls below the lower limit, the words 'ALL PASS' in the bar at the bottom of the screen will change to 'FAILURE'. • If set to Off, the Maximum Inactive Channel power value will be displayed in blue. The bar at the bottom of the screen will indicate measurement in progress.
3 Set the lower MAC limit.	Lower Limit range: -200 to 200 dB
a. [Low MAC Limit]	
b. Enter the number on the numeric keypad.	
c. [Enter]	
4 Set the lower Pilot limit.	Lower Limit range: -200 to 200 dB
a. [Low Pilot Limit]	
b. Enter the number on the numeric keypad.	
c. [Enter]	

Setting Up the Signal Generator

You can set up the signal generator while in the Spectrum Analyzer mode from the Setup menu. For more detailed information on the signal generator setup and operation, refer to [“Using the Signal Generator” on page 200](#)

CAUTION

The maximum power for the RF In and RF Out/SWR port is 20 dBm (100 mW). The maximum power for the Power Sensor port is 24 dBm (300 mW). When directly coupled to a access network, the test set can be damaged by excessive power applied to any of these three ports.

To prevent damage in most situations when you directly couple the test set to a access network, use the high power attenuator between the test set and the BTS.

NOTE

The lowest level the signal generator can go to is -90 dBm. In order to get a lower level, you must use an external attenuator. You can compensate for the attenuator in the RF Out Loss.

Step	Notes
1 [Setup]	
2 [Sig Gen]	
3 [Freq/Chan]	
4 Enter the channel or frequency using the numeric keypad.	
5	<ul style="list-style-type: none"> For channel select [Rev] or [Fwd] For frequency select [GHz], [MHz], [kHz], or [Hz],
6 [Mod Format]	

Step	Notes	
7	Select the channel standard from the list using the up and down arrow buttons.	
8	[Select]	
9	Set the RF output amplitude a. [Amplitude] b. Enter the amplitude value using the numeric keypad. c. [dBm].	You may also enter a new value for amplitude by turning the rotary knob until the desired value is displayed or using the up and down arrow keys.
10	If you have previously stored RF Out Loss from an insertion loss measurement, go to the next step. Or Press [RF OUT Loss] to select On and enter the RF Out Loss value.	For information on the effects of the RF Out Loss function on the amplitude, refer to “Using the RF OUT Loss field,” below. Each time you press this softkey, the selected option changes.
11	Connect to the access network.	
12	On [Enable Sig Gen] select On .	Each time you press this softkey, the selected option changes.

NOTE

The characteristics of any 1xEV-DO signal generated are:

- RRI Active: RRI Bits: 1
- DRC Channel Relative Gain: +3 dB
- ACK Channel relative Gain: 0 dB
- Data Channel Relative Gain: +3.75 dB
- Data Channel: Active

- Data Channel Data Rate: 9.6 kbps
 - Data Channel bit stream: PN15
 - I Mask: 3FF80000000
 - Q Mask: 3FF00000001
 - Filter Type: IS 95 Std
-

Using the RF OUT Loss field

The RF OUT Loss field is used when it is necessary to test the receiver sensitivity of a typical access network. The test set's source will typically go down to -95 dBm. In order to reach -113 dBm for sensitivity testing, you must use an external pad. The measured value of the pad and connecting cables are entered into this field. This value is then used when this field is set to **On**. When this field is set to **On**, the test set will set the RF generator level to the correct level offset by the external pad/cabling. When you set the RF Generator to -113 dBm (with the RF OUT Loss field turned **On** and the external pad/cabling loss value entered) the output at the end of the RF test cabling is -113 dBm.

Example: If you want to set the signal generator to -113 dBm, the pad and RF cabling measures 42.51 dB (measured with the 2 port insertion loss measurement screen prior to this test), the RF OUT Loss field is turned **On** (with the 42.51 dB loss value entered). The actual RF output of the signal generator is -70.49 dBm, the pad and RF cabling attenuated the signal to the desired level; so the RF signal at the end of the test cable/pad is -113 dBm. This also points out the importance of accurately measuring the loss of the pad and connecting cables.

Metrics Provided by the 1xEV-DO Tx Analyzer Measurement

This section contains descriptions of the individual 1xEV-DO transmit parameters in the metric display of the screen. The “Interpretation of 1xEV-DO Tx Analyzer Measurement Results” section contains expected result values and possible causes of error if the expected results are not met.

Frequency

Frequency is the center frequency you entered.

Frequency Error

Frequency error is the frequency difference between your access network’s actual center frequency and the frequency (or channel) you entered. With a valid time reference (GPS or ESC) this will have a range of $\pm 25\text{KHz}$ about the selected centre frequency. For a pure frequency reference it is limited to $\pm 500\text{Hz}$.

PN Offset

The PN Offset is a “short code” sequence that provides a unique identifier for each sector of each cell site. The PN Offsets are applied to the I and Q signals before modulation. PN Offsets are offset in time by $52.08\ \mu\text{s}$ and they repeat every 26.666 ms. This yields 512 unique short code sequences (0-511). The access terminal needs the PN Offset to decode information in the Pilot channel and the MAC channel, both of which are transmitted by the access network.

Time Offset

The Time Offset compares the PN Offset timing with the overall system time. This measurement checks the start of the PN offset in comparison to the GPS signal, or to the Even Second Clock signal. For example, PN Offset 0 should repeat exactly on the rising edge of the Timing Reference. PN Offset 1 should repeat $52.08\ \mu\text{s}$ after the rising edge of the Timing Reference, and so forth. Any deviation in time from that event is reported as a Time Offset.

Non Idle Power

The Non Idle Power is a measurement of the average power during an entire slot when the acquired slot is non-idle. When all of the acquired slots are idle (that is, when Idle Slots shows 100%), the measurement result is blanked out. The number

Metrics Provided by the 1xEV-DO Tx Analyzer Measurement

of slots over which the acquisition is made is determined by the Capture Interval, which itself is determined by the Meas Time setting.

Pilot + MAC Power

The Pilot + MAC Power is a measurement of the average power during the Pilot and MAC periods. When all of the acquired slots are idle (that is, when Idle Slots shows 100%), the measurement result is blanked out. The number of slots over which the acquisition is made is determined by the Capture Interval, which itself is determined by the Meas Time setting.

On/Off Ratio

This refers to the Idle On/Off Power Ratio, which is ratio of the Pilot + MAC Power to the Idle Data Power. The result is blanked out when none of the acquisition slots are idle, that is, when Idle Slots shows 0%. The number of slots over which the acquisition is made is determined by the Capture Interval, which itself is determined by the Meas Time setting.

Idle Data Power

The Idle Data Power is a measurement of the average power during the data period of an idle slot. When none of the acquired slots are idle (that is, when Idle Slots shows 0%), the measurement result is blanked out. The number of slots over which the acquisition is made is determined by the Capture Interval, which itself is determined by the Meas Time setting.

Idle Slots

The Idle Slots measurement shows as a percentage, the number of idle slots out of the total number of slots. Exactly how this percentage figure is worked out depends on the Averaging State you have selected.

If averaging is **Off**, the percentage of idle slots since the last restart is reported.

If averaging is **Off** and your analyzer is in **Single** mode, the percentage of slots within the capture interval is reported.

If averaging is **On**, the result displayed is the percentage of idle slots within 'n' capture intervals, where 'n' is the current average number. Once your desired number of averages has been reached, the result reported is the percentage of idle slots within the last 'n' measurement capture intervals.

Est Pilot Rho

Pilot Rho is the measure of the modulation quality for a 1xEV-DO transmitter. This

measurement is analogous to measuring FM accuracy and distortion in an AMPS network or EVM in a TDMA system. A Rho value of 1.0 represents a perfect signal, indicating that all of the power is being transmitted correctly. Pilot Rho is only measured over the 96 pilot chips contained within every half-slot. The measurement result is blanked out when the code domain measurement does not synchronize to the received input signal. The number of slots over which the acquisition is made is determined by the Capture Interval, which itself is determined by the Meas Time setting.

Est MAC Rho

MAC Rho is the measure of the modulation quality for a 1xEV-DO transmitter. This measurement is analogous to measuring FM accuracy and distortion in an AMPS network or EVM in a TDMA system. A Rho value of 1.0 represents a perfect signal, indicating that all of the power is being transmitted correctly. MAC Rho is only measured over the 128 MAC chips contained within every half-slot. The measurement result is blanked out when the code domain measurement does not synchronize to the received input signal. The number of slots over which the acquisition is made is determined by the Capture Interval, which itself is determined by the Meas Time setting.

Max Inactive Ch

This is a measure of the Maximum Inactive Channel Power. The reported result is the maximum power in the separate I and Q channels when the MAC Channel Walsh Codes are inactive, relative to the total power in both the active and the inactive channels. The number of slots over which the acquisition is made is determined by the Capture Interval, which itself is determined by the Meas Time setting.

The result reported is for the currently selected CDP type, for example, if the selected CDP type is Pilot, this will report the highest power level detected across the inactive channels within the 32 pilot codes.

Noise Floor

The Noise Floor is the average inactive Walsh code power level detected in the combined I and Q channels, relative to the total power in both the active and the inactive channels. The number of slots over which the acquisition is made is determined by the Capture Interval, which itself is determined by the Meas Time setting.

The result reported is for the currently selected CDP type, for example, if the selected CDP type is Pilot, this will report the average power level detected across the inactive channels within the 32 pilot codes.

NOTE

Take care that you do not confuse Noise Floor with Idle Data Power. Idle Data Power is the power present in the data region of the Idle slots. Noise Floor is the average power present in the inactive Walsh Code channels.

Data Channel Modulation

The Data Channel Modulation measurement returns the highest modulation detected within the measurement interval. There are three types of modulation, and hence four possible measurement results: QPSK, 8PSK, and 16QAM, and blank when no modulation is detected. QPSK is the lowest type of modulation, 8PSK is the next higher, and the highest modulation type is 16QAM. Only if all the slots within the measurement interval are idle will the result be blanked out. The number of slots over which the acquisition is made is determined by the Capture Interval, which itself is determined by the Meas Time setting.

Interpretation of 1xEV-DO Tx Analyzer Measurement Results

This section contains expected result values and possible causes of error if the expected results are not met.

Frequency Error

The standards specify very tight Frequency Error performance. In the PCS bands, the 0.05 parts-per-million specification translates to only 99 Hz at a carrier frequency of 1980 MHz or 40 Hz at 850 MHz cellular frequencies. Frequency Error shows up as uncorrelated power that adds to the noise floor or shows up in other Walsh codes.

If a particular site loses its reference to GPS time, its reference signals will begin to drift over time. Access Terminals already using the site can remain on the air because they derive their timing from the signals transmitted by the access network. However, access terminals using other sites/sectors may be prevented from using the site because they are confused by the error in frequency. This creates what is known as the “island cell effect”. By itself, the cell is still functional. To the rest of the system, it's inaccessible.

This island cell effect can be caused by a failure in the site's GPS receiver and timebase distribution network. Using the test set's Internal GPS receiver provides an independent time reference that will allow you to determine if this cell site is out of sync with the rest of the network.

PN Offset

Verify that the PN Offset is correct. If you are in Manual mode, the PN Offset will display the value you entered. Make sure the Time Offset is small (less than 3 μ s). If the Time Offset is greater than expected, see the section on Time Offset below. If you are in Auto mode, the test set will tune to the PN Offset with the smallest amount of Time Offset. If an incorrect PN Offset is displayed, the Time Offset will likely be very small.

Time Offset

Time Offset is a measure of the time of the arrival of the pilot signal from the access network with respect to GPS time. It is expressed in microseconds.

The 1xEV-DO standards specify a maximum time offset of 10 μ s. Generally 5 μ s is a recommended maximum, although many access network manufacturers specify

Interpretation of 1xEV-DO Tx Analyzer Measurement Results

that timing must be within 3 μ s. If the Time Offset is large enough, an “island cell” can occur. The “island cell” effect was mentioned already when discussing Frequency Error.

An access terminal moving outward toward the limit of its cell will need to acquire the adjacent cell in order to hand off. If the time offset of the target cell is too far from that of the current site, the handoff may not happen.

The dependence of the access terminal on correct system time limits the physical distance to a target cell's antenna. Each PN Offset is 52.08 μ s; if the propagation delay is too long, the received PN Offset may be different from the value designated on the Sync channel. This difference can confuse the access terminal, causing the handoff to fail.

Another cause of timing error is a bad GPS receiver or timing distribution network within the access network. To test your access network's GPS and timing distribution system, you can use the internal GPS receiver to generate an accurate timing reference for the test set to use while performing access network tests.

Non Idle Power

When making channel power measurements, make sure you have accounted for the loss of the test cable and high power attenuator you are using. If you do not know the loss of your test cable and high power attenuator configuration, perform an insertion loss measurement and enter the insertion loss as the RF In Loss value. For more information see [“Two Port Insertion Loss” on page 55](#).

If the channel power is lower than expected, verify you have a good connection to the RF output of the access network. Also, verify the cable you are using to connect to the access network is not faulty. A low channel power may also indicate a bad power amplifier.

Inaccurate channel power (high or low) may indicate an incorrect power setting at the access network.

Pilot + MAC Power

The Pilot + MAC Power is a measurement of the average power during the Pilot and MAC periods. This is when the transmitter is only sending overhead messages in a burst mode and is not transmitting any data to users. When the Idle slot activity goes to zero (no idle slots), the Pilot + MAC and a couple of the other measurements blank (as they have no meaning when all slots are active).

On/Off Ratio

The On/Off Ratio is a ratio of the Idle Power to the Noise Floor. The recommended

minimum On/Off Ratio for idle slots was set to 7dB in the standard to allow Access Network manufacturers to protect the power amplifiers from large output power swings between On portions of the signal during bursts and Off portions of the signal in idle slots. Each manufacture may set this value to different levels. This parameter is loaded into the radios from the Switch.

When the Idle slot activity goes to zero (no idle slots), the On/Off Ratio and a couple of the other measurements blank (as they have no meaning when all slots are active).

Idle Data Pwr

This is the average power level in the data portion, averaged across all idle slots in the acquired capture, and can contribute to the overall Noise Floor in the system. A high reading here combined with a high reading in the CDP Noise Floor can indicate a problem with the I/Q Modulator or indicates the amplifier is being overdriven. When the Idle slot activity goes to zero (no idle slots), the Idle Data Power and a couple of the other measurements blank (as they have no meaning when all slots are active).

Idle Slots

This reading is a measure of the number of idle slots, measured as a percentage of the total number of slots available. This reading can be used as a flag to add more capacity at the site as the reading approaches 0%.

Est Pilot Rho

The 1xEV-DO access network standard specifies that Rho must be greater than 0.912. Typical values for a healthy access network are greater than 0.94.

Rho failures can indicate problems in:

- Compression in linear amplifiers
- Magnitude and phase errors in the IQ modulator
- Phase non-linearity (group delay)
- Spurious signals in the transmission path
- Carrier feedthrough

Because the uncorrelated power appears as interference to the access terminals, poor Rho performance will affect the sector's capacity. The added interference can require that the signal on traffic channels be raised to overcome the interference. This may, in turn, be seen as further interference. At some point, the site will have to shed calls in order to supply the remaining calls with enough signal versus the interference in the system.

Interpretation of 1xEV-DO Tx Analyzer Measurement Results

Est MAC Rho

The 1xEV-DO access network standard specifies that Rho must be greater than 0.912. Typical values for a healthy access network are greater than 0.94.

Rho failures can indicate problems in:

- Compression in linear amplifiers
- Magnitude and phase errors in the IQ modulator
- Phase non-linearity (group delay)
- Spurious signals in the transmission path
- Carrier feedthrough

Because the uncorrelated power appears as interference to the access terminals, poor Rho performance will affect the sector's capacity. The added interference can require that the signal on traffic channels be raised to overcome the interference. This may, in turn, be seen as further interference. At some point, the site will have to shed calls in order to supply the remaining calls with enough signal versus the interference in the system.

Max Inactive Ch

According to the 1xEV-DO standard, the CDP in all inactive channels must be at least 27 dB below the total MAC power.

If this value exceeds 27 dBc, compression may be occurring in the base station power amplifier or there may be errors in the base station IQ modulator.

Noise Floor

The light gray bars on the CDP trace display are noise. While they appear to be channels on the trace and are referred to as noise channels, they are not real 1xEVDO channels. They represent the noise energy in the inactive displayed code channel. The average level of the top of these noise bars represents the CDP Trace noise floor, and is the figure reported here.

The noise floor level can be influenced by many conditions one of which can be the existence of high power from another CDMA base station or such things as loose RF connections. It is desirable to reduce the noise floor as much as possible before making measurements. If you have a strong signal on the metrics display but still show a high noise floor, then a problem may exist in the base station.

Data Channel Modulation

The Data Modulation Type measurement returns the highest modulation detected

Interpretation of 1xEV-DO Tx Analyzer Measurement Results

within the measurement interval. There are three types of modulation, and hence four possible measurement results: QPSK, 8PSK, and 16QAM, and blank when no modulation is detected. QPSK is the lowest type of modulation, 8PSK is the next higher, and the highest modulation type is 16QAM. Only if all the slots within the measurement interval are idle will the result be blanked out. The number of slots over which the acquisition is made is determined by the Capture Interval, which itself is determined by the Meas Time setting.

A reading of 16QAM indicates high throughput for the access network. If only QPSK is shown over time, then there may be a problem in the transmit path of the access network.

Customizing Your Display

You can change the way your measurement results are displayed on your analyzer.

The MAC Code Domain Plot in the graphical area of the display can be switched between displaying MAC Code Power sorted by MAC index, and displaying MAC Code Power sorted by Walsh Code.

The same information, sorted either by MAC index or by Walsh Code, can itself be displayed in two different ways. The CDP plot (the default display) can be switched to show a **Codogram**, which adds the third dimension of time to the display. That is, you can view code domain power (sorted by either MAC Index or be Walsh Code) over time.

Sorting by MAC Index or by Walsh Code

The default view of a CDP plot is sorted by MAC Index. This can be changed to a view sorted by Walsh Code. The order used for Walsh Code display is Hadamard.

Step	Notes
1 Press [Display]	
2 Press [MAC CDP X Axis]	Each time you press this softkey, the selected option changes. Select either MAC or Walsh as your preferred display option.

Converting Between MAC Index and Walsh Code

Converting From	Converting To
Even numbered MAC Indexes	Walsh Code = MAC Index / 2
Odd numbered MAC Indexes	Walsh Code = ((MAC Index - 1) / 2) + 32
Walsh Codes 0 - 31	MAC Index = Walsh Code * 2
Walsh Codes 32 - 64	MAC Index = ((Walsh Code - 32) * 2) + 1

Colors Used on the MAC Code Domain CDP Display

MAC Index	Walsh Code	Color	Notes
0	0	Gray if inactive Light brown if active	Reserved channel/code, and should always be inactive. If these are light brown, then channel type is "Unknown".
1	32	Gray if inactive Light brown if active	Reserved channel/code, and should always be inactive. If these are light brown, then channel type is "Unknown".
2	1	Gray if inactive Light brown if active	Reserved channel/code, and should always be inactive. If these are light brown, then channel type is "Unknown".
3	33	Gray if inactive Light brown if active	Reserved channel/code, and should always be inactive. If these are light brown, then channel type is "Unknown".
4	2	Light blue	Reverse activity. Should always be active.

MAC Index	Walsh Code	Color	Notes
>4	3 – 31 and 34 – 63 for CDP Type MAC 64. 3 – 31 and 34 – 127 for CDP Type MAC 128.	Gray if inactive (or “noise”) Orange if active	.Orange indicates active MAC RPC channels. Active channels display the Walsh Code/MAC Index below the graticule in yellow text.

Colors Used on the Pilot Code Domain CDP Display

Walsh Code	Color	Notes
0	Always red	Pilot
1 – 31	Always gray (inactive)	Noise.

Displaying the Codogram

Switching to the **Codogram** view adds the third dimension of time to the display. That is, you can view code domain power (sorted by either MAC Index or be Walsh Code) over time. MAC Indexes or Walsh Codes are displayed against the horizontal X-axis, time is represented on the vertical Y-axis, and signal strength is indicated by the color - low power signals are represented by the cooler, blue end of the spectrum, and high power signals by the warmer, red end of the spectrum.

The codogram plot rises over time until it fills the graphical section of the display. In this way, you can clearly see the changes in power that occur over a period of time.

Step	Notes
1 Press [Display]	
2 Press [Codogram]	This displays the menu that controls the appearance and behavior of the codogram display.

Step	Notes
3 Press [Codogram]	Each time you press this key, the codogram state switches between On and Off .

Codogram Settings

The appearance and behavior of the codogram display can be changed by using the keys in the codogram menu.

Step	Notes
1 Press [Display]	
2 Press [Codogram]	This displays the menu that controls the appearance and behavior of the codogram display.
3a Press [Reset Codogram]	Each time you press this key, the codogram display is cleared, the timer is restarted, and a fresh plot is started.
3b Press [Capture Interval]	You use this key to change the Capture Interval. By default the Capture Interval is set to zero, and every measurement is displayed on the codogram plot. You can display measurements over a longer period of time by increasing the Capture Interval. For example, if you set the Capture Interval to 5, the result of every 6th measurement is recorded on the codogram.
3c Press [Palette]	Use this key to select between a full color display and a grayscale display.

- [“Using the GSM Analyzer” on page 398](#)
- [“Performing a Basic GSM Transmitter Measurement” on page 399](#)
- [“Interpreting the Display” on page 402](#)
- [“Setting the Channel or Frequency Step” on page 403](#)
- [“Adding or Deleting a List Item” on page 404](#)
- [“Reference Level” on page 405](#)
- [“Setting the Display Position” on page 405](#)
- [“Setting Auto Order” on page 406](#)
- [“Setting Bar Top and Units” on page 406](#)
- [“Setting Mid-Bar” on page 407](#)
- [“Setting Auto Mode Bar Count” on page 407](#)
- [“Setting the Pass/Fail Limits” on page 408](#)
- [“Compensating for the Loss of an External Cable and Attenuator” on page 409](#)
- [“Setting Average, Sweep, and Restart” on page 410](#)
- [“GSM Band Data” on page 412](#)
- [“Metrics Provided by the GSM Analyzer Measurement” on page 414](#)
- [“Interpretation of GSM Analyzer Measurement Results” on page 416](#)

Using the GSM Analyzer

GSM transmitter measurements verify proper transmitter performance and can be made with the base station in service or out of service. Important metrics are:

- Frequency Error
- BSIC
- Peak Channel Power
- Occupied Bandwidth
- RMS phase Error
- Peak Phase Error
- IQ Offset

The measurements conform to the following GSM standards:

- GSM 450
- GSM 480
- GSM 850
- GSM 900
- DCS 1800
- PCS 1900

CAUTION

The maximum power for the RF In and RF Out/SWR port is 20 dBm (100 mW). When directly coupled to a base station, the test set can be damaged by excessive power applied to either of these ports.

To prevent damage in most situations when you directly couple the test set to a base station, use the high power attenuator between the test set and the BTS.

NOTE

To prevent unusual display information from being shown, ensure that you have selected a valid GSM Standard. It is possible for you to set a Chan Std that allows you to enter a lower Stop channel number than the current Start channel number resulting in unusual information in the display. This is because some of the channel standards have discontinuities and reversals in channel numbers.

Performing a Basic GSM Transmitter Measurement

The first step in measuring GSM transmitter performance is to take the base station out of service or, for an inservice measurement, connect the test set to the coupled port. You must also know the channel or frequency of the GSM signal to be analyzed.

To Make GSM Tx Analyzer Measurement:

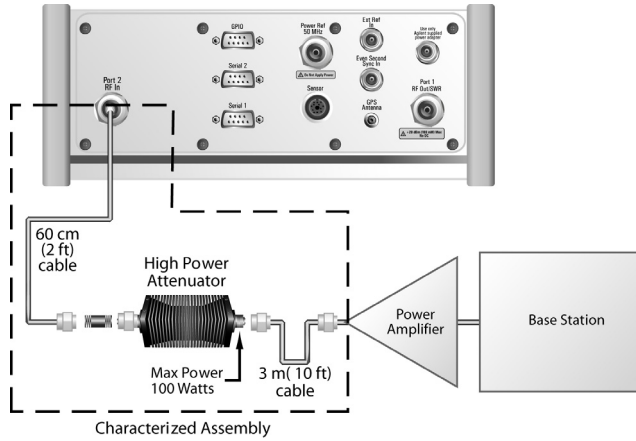
Step	Notes	
1	Mode	
2	[Tx Analyzer]	
3	[GSM Analyzer]	
4	[Chan Std]	
5	Highlight the channel standard you want using the up and down arrow buttons.	
6	[Select]	
7	On [Scan Mode] select Range , Auto , or List . a. If you selected Range or Auto , go to step 8. b. If you selected List , go to step 9.	Each time you press this menu key, the selected option changes.

GSM Analyzer

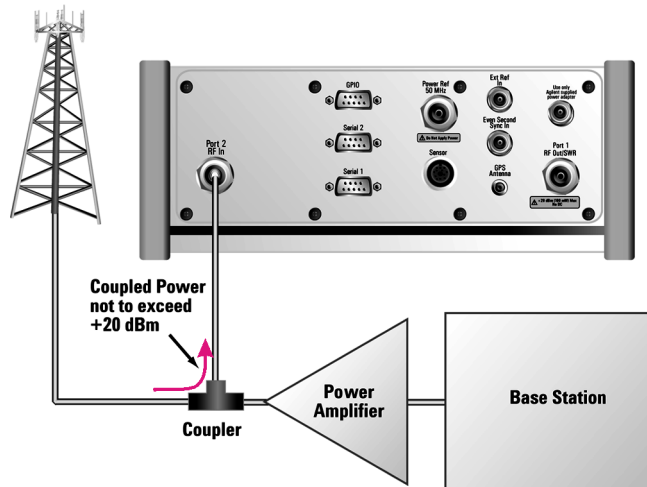
Using the GSM Analyzer

Step	Notes
8	<p>If you selected Range or Auto, you may set Start and Stop frequency/channel and the Step Size of the display range.</p> <ol style="list-style-type: none"> On [Start Chan] enter the channel or frequency using the numeric keypad. On [Stop Chan] enter the channel or frequency using the numeric keypad On [Step Size] enter the channel or frequency step using the numeric keypad
9	<p>If you selected List, you may select and change any or all of the available Freqs/Chans on the List screen.</p> <ol style="list-style-type: none"> [List] Highlight the list item you want using the up and down arrow buttons. Enter a new Freqs/Chans. Repeat steps b and c as necessary. [OK]
10	<p>Connect to the base station.</p>

Step	Notes
------	-------



Out of service connection



In service connection

11 [Level/Location]

12 [Autoscale]

GSM Analyzer

Using the GSM Analyzer

Interpreting the Display

The GSM Tx Analyzer screen is divided into two sections:

- The trace display; that is, the graphic bar chart taking up most of the screen
- The metrics display; that is, a table of values at the bottom of the screen

The **Trace Display** contains a channel power display. In this display, the power of each selected channel is shown. The Y-axis labels display the absolute power (dBm), and dB/division. The X-axis labels display the frequency or channel number. GSM Tx Analyzer Channel Scanner uses the 'Peak Detector' and therefore the displayed bar height is the 'Peak power in the acquisition'. The selected Scan Mode provides different trace display data formats:

- **Range Mode:** All channels between the Start and Stop Freq/Channel are displayed. The channels are separated by the Freq/Channel Step value. Metrics are only computed for the single channel indicated by the vertical yellow line, which can be adjusted by using the [Display], [Position] softkeys (see [“Setting the Display Position” on page 405](#) for further details).
- **Auto Mode:** All channels between the Start and Stop Freq/Channel are examined, but only the channels with the highest power are measured. Metrics are computed for all of the displayed channels, but are only displayed for the single channel indicated by the vertical yellow line, which can be adjusted by using the [Display], [Position] softkeys (see [“Setting the Display Position” on page 405](#) for further details). The maximum number of displayed channels is 20.
- **List Mode:** All channels in the list are measured. Metrics are computed for all of the displayed channels, but are only displayed for the single channel indicated by the vertical yellow line, which can be adjusted by using the [Display], [Position] softkeys (see [“Setting the Display Position” on page 405](#) for further details). The maximum number of list items is 40.

The *metrics display* shows measurement parameters displayed below the trace display in three columns and three rows—each with a value and units (the exception is BSIC, which has no units.) For more information about the parameters in the metric display, refer to [“Metrics Provided by the GSM Analyzer Measurement” on page 414](#).

The frequency indicator is at the bottom right, and the time reference indicator at the bottom left. For each indicator the text indicates which reference you have chosen. A green LED indicates a locked condition, a red “X,” an unlocked condition.

Optional GSM Tx Analyzer Measurement Settings

You can change several optional measurement parameters in the GSM Tx Analyzer:

- [“Setting the Channel or Frequency Step” on page 403](#)
- [“Adding or Deleting a List Item” on page 404](#)
- [“Reference Level” on page 405](#)
- [“Setting the Display Position” on page 405](#)
- [“Setting Auto Order” on page 406](#)
- [“Setting Bar Top and Units” on page 406](#)
- [“Setting Mid-Bar” on page 407](#)
- [“Setting Auto Mode Bar Count” on page 407](#)
- [“Setting the Pass/Fail Limits” on page 408](#)
- [“Compensating for the Loss of an External Cable and Attenuator” on page 409](#)
- [“Setting Average, Sweep, and Restart” on page 410](#)

Setting the Channel or Frequency Step

The Channel or Frequency Step sets the distance between the measured channels. The GSM standard has a channel spacing of 200 kHz, but the signal is actually somewhat wider than that. Therefore service providers often space their channels 400 kHz apart. The entered step value must be a multiple of 200 kHz.

Step	Notes
1 [Step Size]	This choice depends on the [Units] mode you are using.
2 Enter the desired channel or frequency step using the numeric keypad.	

GSM Analyzer

Optional GSM Tx Analyzer Measurement Settings

Step	Notes
3 [Enter] OR [Hz], [kHz], [MHz], or [GHz]	This choice depends on the [Units] mode you are using. Notice (and verify) that the number you entered appears below the Chan Step or Freq Step text on the corresponding button.

Adding or Deleting a List Item

You may add and delete list items from the Scan Mode List for the specific channel/frequency ranges you want to measure.

Step	Notes
1 Enter channels into the list. a. Use [Insert Row] to add a channel. First highlight a row, then use [Insert Row] to insert a row below the highlighted row. Then enter its number using the numeric keypad and [Fwd] or [Rev] to complete each entry. b. Use [Delete Row] to remove channels you do not want displayed. Select a channel you want to remove using the up and down arrow buttons. Then press [Delete Row] to remove the selected channel. c. [Ok]	The maximum number of list items is 40. If the number of channels displayed is 20 or fewer, a single bar graph is used to display them. If the number of channels displayed is greater than 20, two bar graphs are used to display them.

Reference Level

You can adjust the absolute amplitude represented by the top graticule line on the display (the reference level). Also, you can set the units per vertical graticule division on the display. When [Autoscale] is selected, [Ref Level] and [Scale/Div] are automatically calculated and any manually entered values will be reset.

To Set the Reference Level and Scale/Div:

Step	Notes
1	[Level/Location]
2	[Ref Level]
3	Enter the reference level using the numeric keypad, the up and down arrows, or the knob.
4	[dBm] or [W]
5	[Scale/Div]
6	Enter the graticule spacing value using the numeric keypad
7	[dB]

Setting the Display Position

You can set the location or position of the vertical yellow line (channel of interest indicator). This determines the channel used to calculate the measurement metrics displayed in the metrics portion of the display.

To Set the Display Position:

Step	Notes
1	[Display]
2	[Position]

GSM Analyzer

Optional GSM Tx Analyzer Measurement Settings

Step	Notes
3	Enter the desired channel number or frequency using the numeric keypad, the up and down arrows, or the knob.
4	<p>If Frequency/Channel Units have been set to Chan, select [Fwd] or [Rev]</p> <p>If Frequency/Channel Units have been set to Freq, select [GHz], [MHz], [kHz], or [Hz]</p>

Setting Auto Order

You can select the order that the channel bars are displayed. You can set them to be arranged in order of the relative power level or in order of the channel frequency. If you select **Pwr**, the bars are arranged in order of descending power. If you select **Freq**, the bars are arranged in order of ascending frequency.

To Set Auto Order:

Step	Notes
1	[Display]
2	<p>On [Auto Order] select Pwr or Freq.</p> <p>Each time you press this menu key, the selected option changes. This option is grayed out when [Scan Mode] is not set to Auto.</p>

Setting Bar Top and Units

You can set the channel power to be displayed (in dBm or watts) at the top of the channel bars. This only affects the power displayed on the top of the bars. The vertical scale of the graph does not change.

To Set Bar Top:

Step	Notes
1 [Display]	
2 On [Bar Top] select Off or Pwr.	Each time you press this menu key, the selected option changes.
2 On [Units] select dBm or Watts.	Each time you press this menu key, the selected option changes.

Setting Mid-Bar

You can set BSIC to be displayed at the middle of the channel bars.

To Set Mid-Bar:

Step	Notes
1 [Display]	
2 On [Mid-Bar] select Off or BSIC.	Each time you press this menu key, the selected option changes.

Setting Auto Mode Bar Count

The **Measurement Bar Count** setting allows you to alter the number of channel data bars displayed when you set the [Scan Mode] to **Auto**. The channels that have the highest power will be displayed, up to the number of channels you have set.

To Set the Measurement Auto Mode Bar Count:

Step	Notes
1 [Setup]	
2 [Auto Mode Bar Count]	
3 Enter the number of bars to display using the numeric keypad, the up and down arrows, or the knob.	The maximum number of bars displayed is 20.

GSM Analyzer

Optional GSM Tx Analyzer Measurement Settings

Step	Notes
4 [Enter]	If you use the up and down arrows or the knob to change the bar count number, the Enter key will not be displayed. However, the display will update to the entered number of bars after a few seconds.

Setting the Pass/Fail Limits

The measurement limits setting allows you to alter the value of the upper and lower test limits. Limits are set in dBm and are absolute. The settings you choose define the location of the limit lines displayed on the screen. These settings affect the metrics color display: red represents fail, green represents pass.

To Set the Measurement Upper and Lower Limits:

Step	Notes
1 [Setup]	
2 [Limits]	
3 [Power Limits]	
4 [On] or [Off]	
5 Set the upper limit.	
a. [High Limit]	
b. Enter the number on the numeric keypad.	
c. [dBm]	
6 Set the lower limit.	
a. [Low Limit]	
b. Enter the number on the numeric keypad.	
c. [dBm]	

Compensating for the Loss of an External Cable and Attenuator

The insertion loss of the test cable and high power attenuator must be compensated for to obtain accurate GSM power measurements. This process is called “normalization” and is described in [“Measuring Two Port Insertion Loss” on page 56](#). The insertion loss of the combination of test cable and attenuator is accounted for as the RF In Loss, which is an offset applied to the power measurements by the test set.

Step	Notes
1 [Level/Location]	
2 [RF IN Loss]	
3 Enter the RF In loss using the numeric keypad.	<p>If you are using a cable and additional devices connected to the antenna, enter the combined cable and device RF In loss here. The RF In loss can be obtained by measuring the Insertion loss. See “Two Port Insertion Loss” on page 55.</p> <p>Note: If data had been previously entered in [RF In Loss], that data will be lost and replaced by the value you enter here.</p>
4 [dB]	

Setting Average, Sweep, and Restart

Setting the Sweep

You can select either continuous or single sweep. Continuous sweep provides repeated, ongoing measurements. Single sweep performs a single measurement that is repeated only when you push the Single button.

To set sweep:

Step	Notes
1 [Average/Sweep]	
2 [Continuous] or [Single]	Each time you press this menu key, the selected option changes.

Setting Averaging

You can choose to have averaging on or off and set the number of averages you want to take. Averaging only applies to measuring of the channel power. GSM modulation metrics are not averaged. You can select from the following types of averaging:

- **Off:** Disables averaging.
- **Running:** Computes the new result as the weighted sum of the last result and the new measurement. The last result is weighted by $(n - 1)/n$. The new result is weighted by $1/n$. Each new measurement produces a new result.
- **Max Hold:** Is not an average, but on a point by point basis, displays the maximum amplitude for the given frequency or channel since Max Hold was turned on. It is updated when a new maximum occurs.
- **Group Average:** Makes the requested number of measurements, averages the measurement data, and displays the average as a single result-trace. Measurement time will vary based on the requested number of averages and can take minutes for very large number of averages.
- **Group Max Average:** Makes the requested number of measurements before returning a single result-trace. This trace is the maximum value seen at each trace point over the requested number of averages (measurements).

To set averaging:

Step	Notes
1	Set the number of averages. <ol style="list-style-type: none"> a. [Average/Sweep] b. [Average] c. Enter the number of averages using the numeric keypad. d. [Enter]
2	Select the type of averaging you want to apply. <ol style="list-style-type: none"> e. [Averaging] f. [Off], [Running Average], [Max Hold], [Group Average], or [Group Max Average]

NOTE

These two steps can be performed in any order. However, if you turn averaging on and a large number of averages has previously been set, there may be a delay before you can change number of averages.

Setting Restart

When you have averaging turned **On** and you are in **Continuous** Sweep mode, you can restart the averaging by pressing the Restart menu key. The Restart key has no effect if you are in **Single** sweep mode.

To restart averaging:

Step	Notes
1	[Average/Sweep]
2	[Restart]

This key is unavailable or has no effect when **Sweep** is set to **Single**. To restart a Single Sweep measurement, press [Single].

GSM Band Data

The standard includes multiple traffic channels, a control channel, and a cell broadcast channel. The GSM specification defines a channel spacing of 200 kHz.

GSM 450, GSM 480, GSM 900, GSM 850, DCS 1800, and PCS 1900 are GSM-defined frequency bands. The term GSM 900 is used for any GSM system operating in the 900 MHz band, which includes P-GSM, E-GSM, and R-GSM. Primary (or standard) GSM 900 band (P-GSM) is the original GSM band. Extended GSM 900 band (E-GSM) includes all the P-GSM band plus an additional 50 channels. Railway GSM 900 band (R-GSM) includes all the E-GSM band plus additional channels.

DCS 1800 is an adaptation of GSM 900, created to allow for smaller cell sizes for higher system capacity. PCS 1900 is intended to be identical to DCS 1800 except for frequency allocation and power levels. The term GSM 1800 is sometimes used for DCS 1800, and the term GSM 1900 is sometimes used for PCS 1900. For specifics on the bands, refer to “[GSM Band Data](#)” table below.

The framing structure for GSM measurements is based on a hierarchical system consisting of timeslots, TDMA frames, multiframe, superframes, and hyperframes. One timeslot consists of 156.25 (157) symbol periods including tail, training sequence, encryption, guard time, and data bits. Eight of these timeslots make up one TDMA frame. Either 26 or 51 TDMA frames make up one multiframe. Frames 13 and 26 in the 26 frame multiframe are dedicated to control channel signaling.

Table 16-1 GSM Band Data

	GSM 450	GSM 480	GSM 850	P-GSM (GSM 900)	E-GSM (GSM 900)	R-GSM (GSM 900)	DCS 1800 (GSM 1800)	PCS 1900 (GSM 1900)
Uplink (MS Transmit)	450.4 to 457.6 MHz	478.8 to 486.0 MHz	824 to 849 MHz	890 to 915 MHz	880 to 915 MHz	876 to 915 MHz	1710 to 1785 MHz	1850 to 1910 MHz
Downlink (BTS Transmit)	460.4 to 467.6 MHz	488.8 to 496.0 MHz	869 to 894 MHz	935 to 960 MHz	925 to 960 MHz	921 to 960 MHz	1805 to 1880 MHz	1930 to 1990 MHz
Range (ARFCN)	259 to 293	306 to 340	128 to 251	1 to 124	0 to 124 and 975 to 1023	1 to 124 and 955 to 1023	512 to 885	512 to 810
TX/RX Spacing (Freq.)	45 MHz	45 MHz	45 MHz	45 MHz	45 MHz	45 MHz	95 MHz	80 MHz
TX/RX Spacing (Time)	3 timeslots	3 timeslots	3 timeslots	3 timeslots	3 timeslots	3 timeslots	3 timeslots	3 timeslots
Modulation Data Rate GMSK (kbits/s):	270.833	270.833	270.833	270.833	270.833	270.833	270.833	270.833
Frame Period	4.615 ms	4.615 ms	4.615 ms	4.615 ms	4.615 ms	4.615 ms	4.615 ms	4.615 ms
Timeslot Period	576.9 μ s	576.9 μ s	576.9 μ s	576.9 μ s	576.9 μ s	576.9 μ s	576.9 μ s	576.9 μ s
GSM Bit and Symbol Period	3.692 μ s	3.692 μ s	3.692 μ s	3.692 μ s	3.692 μ s	3.692 μ s	3.692 μ s	3.692 μ s
Modulation GSM	0.3 GMSK	0.3 GMSK	0.3 GMSK	0.3 GMSK	0.3 GMSK	0.3 GMSK	0.3 GMSK	0.3 GMSK
Channel Spacing	200 kHz	200 kHz	200 kHz	200 kHz	200 kHz	200 kHz	200 kHz	200 kHz
TDMA Mux	8	8	8	8	8	8	8	8
Voice Coder Bit Rate	13 kbits/s	13 kbits/s	13 kbits/s	13 kbits/s	13 kbits/s, 5.6 kbits/s	13 kbits/s	13 kbits/s	13 kbits/s

Metrics Provided by the GSM Analyzer Measurement

This section contains descriptions of the individual GSM transmit parameters in the metrics display of the screen. The “Interpretation of GSM Tx Analyzer Measurement Results” section contains expected result values and possible causes of error if the expected results are not met.

Frequency

Frequency of the channel indicated by the vertical yellow line on the display. The position of this yellow line can be adjusted by using the [Display], [Position] softkeys (see “[Setting the Display Position](#)” on page 405 for further details).

Frequency Error

Frequency error is the frequency difference between your transmitter's actual center frequency and the frequency (or channel) you entered.

BSIC (Base Station Identification Code)

A two digit number that identifies the base station for the indicated channel. It consists of the PLMN color code with a range from 0 to 7, and the S color code with a range from 0 to 7. The BSIC is shown in Decimal format $(8 * NCC) + BCC$. For example, if the NCC is 4, BCC is 3, the BSIC will be 35 ($4*8+3 = 35$). BSIC is transmitted on a synchronization channel and is used to identify a cell and to indicate the timing sequence being used.

- BCC = Base station Color Code
- BSIC = Base Station Identity Code
- NCC = Network Color Code
- PLMN = Public Land Mobile Network

Max TS Pwr (Maximum Timeslot Power)

The average power of the highest power timeslot in the acquired frame. This is the absolute power level and displayed in both dBm and watts.

OBW (Occupied Bandwidth)

This is the 99% power bandwidth of the centered 500 kHz span at the channel frequency. In other words, the total power of 500 kHz span centered at the channel frequency is computed, then the bandwidth that contains 99% of the total power is

returned as the occupied bandwidth.

RMS and Pk Phase Error

Phase error is the fundamental measure of modulation quality in GSM systems. Since GSM systems use relative phase to transmit information, the phase accuracy of the GSM transmission is critical to the system's performance, and ultimately to its effective range.

The phase error is computed by measuring the test signal and computing the difference between the phase of the transmitted signal and the phase of a theoretically perfect signal.

RMS Phase Error: This is the RMS of the phase error (in degrees) between the measured phase and the ideal phase of a TCH timeslot. The GSM standard specifies the RMS phase error not to exceed 5 degrees during the useful part of the GSM burst.

Pk Phase Error: Peak phase error is the maximum phase error (in degrees) between the measured phase and the ideal phase of a TCH timeslot, at a single instant. The GSM standard specifies the peak phase error not to exceed 20 degrees during the useful part of the GSM burst.

IQ Offset

I/Q origin offset is a value in dB of the I and Q error (magnitude squared) offset from the origin. It indicates the magnitude of the carrier feedthrough signal. When there is no carrier feedthrough, I/Q Offset is zero.

Interpretation of GSM Analyzer Measurement Results

This section contains expected result values and possible causes of error if the expected results are not met.

Frequency Error

The GSM standard specifies very tight frequency error performance. In the GSM 900 band, the 0.05 ppm (parts-per-million) specification translates to only 45 Hz error.

Frequency error measurements indicate synthesizer/phase lock loop performance. This is especially important in a BTS with frequency hopping active. Poor frequency error measurements can show, for example, that a synthesizer is failing to settle quickly enough as it shifts frequency between transmissions. Poor frequency error can cause a multitude of problems, for example, the target receiver may be unable to gain lock, and the transmitter may cause interference with other users.

You will need to use an external reference or GPS (if available) in order to achieve an accurate frequency error reading.

BSIC (Base Station Identity Code)

If the BSIC can not be decoded, dashes will be displayed. If it is not as expected, check the base station settings against the plan.

Max TS Pwr (Maximum Timeslot Power)

Maximum Timeslot Power is the measure of in-channel power for GSM Systems. The purpose of the Maximum Timeslot Power measurement is to determine the power delivered to the antenna system in the radio frequency/channel under test. The Maximum Timeslot Power measurement verifies the accuracy of the transmitted RF carrier power.

If the maximum timeslot power is lower than expected, verify you have a good connection to the RF output of the base station. Also, verify the cable you are using to connect to the base station is not faulty. A low power may also indicate a bad power amplifier.

Inaccurate channel power (high or low) may indicate an incorrect power setting at the base station.

Phase Error and IQ Offset

Phase error is the fundamental measure of modulation quality in GSM systems. Since GSM systems use relative phase to transmit information, the phase accuracy of the GSM transmission is critical to the system's performance, and ultimately to its effective range.

The phase error is computed by measuring the test signal and computing the difference between the phase of the transmitted signal and the phase of a theoretically perfect signal.

Poor phase error or I/Q offset could indicate a problem with the I/Q baseband generator, filters, or modulator in the transmitter circuitry. The output amplifier in the transmitter can also create distortion that causes unacceptably high phase error. Poor phase error will reduce the ability of a receiver to correctly demodulate signals, especially in marginal signal conditions. This ultimately affects range.

GSM Analyzer
Interpretation of GSM Analyzer Measurement Results

- “Using the CDMA Over Air Tool” on page 420
- “Preparing to Make CDMA Over Air Measurements” on page 420
- “Criteria for Making Valid CDMA Over Air Measurements” on page 421
- “Performing a Basic CDMA Over Air Measurement” on page 422
- “Displaying Location Information Using GPS” on page 424
- “Setting Amplifier Capacity Metrics” on page 425
- “Interpreting the Display” on page 426
- “Optional CDMA Over Air Measurement Settings” on page 428
- “Setting the Channel or Frequency Step” on page 428
- “Setting the PN Increment” on page 429
- “Setting the Transmitter Reference Level” on page 429
- “Setting the Active Channel Threshold Level and Auto Threshold Level” on page 431
- “Resetting Amplifier Capacity and Traffic Metrics” on page 432
- “Setting Measurement Time” on page 432
- “Setting Quick Page Channel” on page 433
- “Setting Average, Sweep, and Restart” on page 435
- “Adding a Marker” on page 436
- “Setting the Pass/Fail Limits” on page 438
- “Setting Up the Signal Generator” on page 447
- “Metrics Provided by CDMA Over Air Measurements” on page 450
- “Interpretation of CDMA Over Air Measurement Results” on page 454

Using the CDMA Over Air Tool

CDMA over air measurements provide a quick method of verifying CDMA transmitter performance. These transmitter measurements can be made on a base station from the convenience of your vehicle without taking the base station out of service. Over air measurements are especially useful in maintaining hard-to-access cell sites such as pole top base stations. The CDMA Over Air option may also be used to measure signals at a coupled port on the transmitter.

For out-of-service CDMA transmitter measurements, the CDMA Tx Analyzer option is recommended. For more information refer to [“CDMA Analyzer” on page 295](#).

CAUTION

To achieve valid over-the-air measurements, the test set must be stationary (not moving). An alternative is to make these measurements from a coupled port at the base station.

Preparing to Make CDMA Over Air Measurements

An important consideration when making CDMA over air measurements is your location relative to the base station. There must be no obstructions between your location and the base station antennas. Also, the GPS antenna must be able to “see” the satellites to obtain lock. Using internal GPS for the time reference has the same advantages mentioned for CDMA Tx Analyzer measurements (“island cell” detection).

You must know the channel or frequency and the PN offset of the CDMA signal to be analyzed. Each base station sector has a unique PN offset. For more information on PN offsets refer to the [“Metrics Provided by CDMA Over Air Measurements” on page 450](#).

Once you have connected the proper antenna to the test set, chosen a stationary location, and verified that you have a clear view of the base station antennas, you can perform CDMA over air measurements.

If this is the first CDMA over air measurement for this base station, you must find a location that meets the criteria for making a valid measurement. Your location must have a dominant pilot and very low multipath power. If you have made CDMA over air measurements at this location before and know it provides valid measurements, skip to [“Performing a Basic CDMA Over Air Measurement” on page 422](#).

Criteria for Making Valid CDMA Over Air Measurements

The first step in making valid CDMA over air measurements is to identify a target base station to measure. Then, for your measurements to be valid, you must find a location near the target base station with a sufficiently strong CDMA signal. CDMA over air measurements will experience interference from other CDMA signals on the same RF channel and from multipath echoes. The code domain power view measures two key parameters to indicate these effects:

- Pilot dominance—The difference between the energy of the strongest pilot channel and the combined energy in the second and third strongest pilot channels (expressed in dB). Ideally, this value should be very large (> 16 dB)
- Multipath power—The amount of power, of the dominant pilot signal, that is dispersed outside the main correlation peak due to multipath echoes (expressed in dB). Ideally, this value should be very small (< 0.1 dB). **Multipath power** is the result of portions of the original broadcast signal arriving at the receiving antenna out of phase with the main power of the original signal. This can be caused by the signal being reflected off of objects, such as buildings, or being refracted through the atmosphere differently from the main signal. These out of phase signals can cancel power from the main signal or appear as noise interference at the receiver.

The table below shows the quality of the over air code domain measurements with respect to pilot dominance and multipath power.

Table 17-1 **Over Air Code Domain Measurement Quality**

Measurement Quality	Pilot Dominance	Multipath Power
Very good	> 16 dB	< 0.1 dB
Fair	> 10 dB	< 0.4 dB
Marginal	> 8 dB	< 0.7 dB

The default measurement limits for pilot dominance and multipath power are set to give “fair” measurement quality. If these limits are met, the pilot dominance and multipath power values will be displayed in green. When the pilot dominance and multipath power parameters are outside the acceptable limits, the parameters will turn red. If this occurs, you must move to a different location that meets the “fair” criteria defined above.

CDMA Over Air

Using the CDMA Over Air Tool

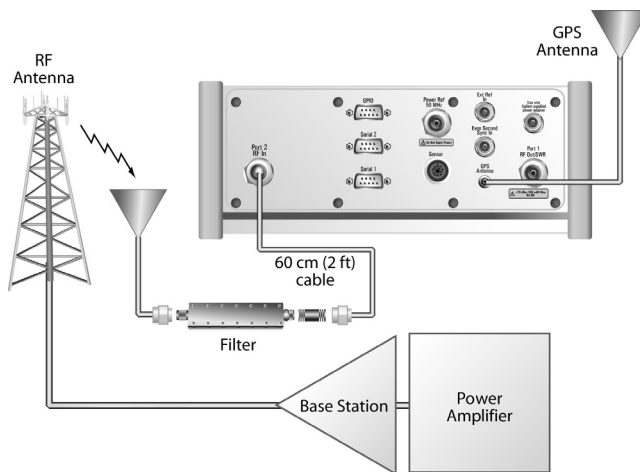
In general, you should always use a preselector filter for the band of interest to prevent strong signals from swamping out the signal of interest. Agilent offers these preselectors and antennas:

- Option 810—Cellular downlink band preselector and antenna
- Option 811—PCS downlink band preselector and antenna
- Option 812—Korean PCS downlink band preselector and antenna

Performing a Basic CDMA Over Air Measurement

Step	Notes
1 Mode	
2 [Over Air]	
3 [CDMA Over Air]	
4 [Chan Std]	
5 Select the channel standard you want using the up and down arrow buttons.	
6 [Select]	
7 On [Units] select Chan or Freq .	Each time you press this softkey, the selected option changes.
8 [Channel] or [Frequency]	<ul style="list-style-type: none">• If you selected Chan in the previous step, select [Channel].• If you selected Freq, select [Frequency].
9 Enter the channel or frequency using the numeric keypad.	
10 [Fwd]	Selects the forward CDMA channel.

Step	Notes
11	Verify that on [Fr/Time Ref] GPS is selected. If not, press [Fr/Time Ref], then press [GPS].
12	On [PN Offset] select Auto or Manual . <ul style="list-style-type: none"> The test set defaults to Auto mode. <ul style="list-style-type: none"> In Auto mode the test set finds the PN offset of the strongest pilot signal and displays the value in the metrics display. The delay is derived from the found PN offset. In Manual mode you must enter the PN offset using the numeric keypad. The delay is derived from the entered PN offset.
13	[Level/Location]
14	[RF IN Loss]
15	Set the RF IN Loss to 0 dB using the numeric keypad.
16	[dB]
17	Connect to the antenna.



CDMA Over Air

Using the CDMA Over Air Tool

NOTE The test set does not record data for post-processing. It provides a snapshot of CDMA base station transmit parameters at that location.

NOTE During a CDMA over air measurement, a yellow triangle symbol may temporarily appear beside “GPS” in the lower right. The yellow triangle indicates that the test set is re-synching with the GPS even second pulse. Once the test set is synched, a green dot appears in place of the triangle. If the GPS is unavailable, a red X appears.

Displaying Location Information Using GPS

If you are making CDMA over air measurements at a location you previously established as valid, Agilent recommends using GPS to verify that you are at the location from which you previously measured.

If you are making CDMA over air measurements from a new location, once you validate that the location provides a dominant pilot and low multipath power, Agilent recommends that you record the latitude and longitude coordinates of this location using GPS. Later measurements should be made from this precise location to provide performance trends.

For additional information on the GPS Data function, refer to [“Displaying GPS Location Data” on page 496](#)

To Display GPS Location Information:

Step	Notes
1	[Level/Location]

Step	Notes
2 On [Show GPS Location] select On .	<p>Displays GPS satellite location information. Uses the internal GPS to capture the location of a measurement. The GPS information can be used to return to the same location. The Time Ref (Freq/Chan/Time Ref mode) button must be set to internal GPS for this function to be active. Information logged includes longitude, latitude, altitude (feet/meters), and the number of satellites tracked.</p> <p>Every time you press [Show GPS Location], the GPS location display alternates between On and Off.</p>

NOTE

If you prefer to have an electronic copy of the location information, see [“Saving Data” on page 503](#).

Setting Amplifier Capacity Metrics

The Amplifier Capacity measurement is an estimate of the amount of power amplifier capacity that is being used, expressed in percent of maximum. Amplifier capacity properties must be properly set to make valid amplifier capacity measurements. Amplifier capacity metrics are amplifier capacity, peak amplifier capacity, and average amplifier capacity.

A CDMA base station is typically set up with a specified amount of power allocated to the pilot channel, and specified power settings of the paging and sync channels are defined relative to the pilot channel. Occasionally, the paging and sync channels power settings will also be specified in absolute power units (watts or dBm). Given the pilot, paging, and sync power setup values and the maximum power output of the amplifier, the percentage amplifier capacity setup parameters can be determined.

To Set Amplifier Capacity Properties:

Step	Notes
1 [Reset/Display/Amp Cap]	
2 On [Amp Cap] select On .	

CDMA Over Air

Using the CDMA Over Air Tool

Step	Notes
3 [Pilot Pwr]	
4 Enter the pilot power in watts, using the numeric keypad.	The pilot power is the total power in the dominant pilot signal, expressed in dBm or in watts.
5 [dBm] or [W]	
6 [Max PA Pwr]	
7 Enter the maximum power amplifier power in watts, using the numeric keypad.	A base station power amplifier is specified to have a maximum power limit.
8 [dBm] or [W]	
9 [Delta Page Pwr]	
10 Enter the Delta Page Pwr in dB, using the numeric keypad.	The delta paging power is the power level of the paging channel expressed as a dB value relative to the pilot channel power level.
11 [dB]	
12 [Delta Sync Pwr]	
13 Enter the Delta Sync Pwr in dB, using the numeric keypad.	The delta sync power is the power level of the the sync channel expressed as a dB value relative to the pilot channel power level.
14 [dB]	

Interpreting the Display

The CDMA Over Air screen is divided into three sections: the code domain trace display, strongest pilot trace display, and metrics display.

The *code domain trace display* contains 128 Walsh codes, which are shown in a bit-reversed order to represent the combined code channels for the varying data rate traffic channels. The Y-axis labels display the relative power (dB) or absolute power (dBm), threshold level, and dB/division. The X-axis labels display active channel Walsh Code numbers. Active code channels shown on the display include:

- Pilot (red)

- Page (green)
- Sync (blue)
- Quick page (light blue)
- IS-95 traffic (yellow)
- cdma2000 traffic (orange)
- Unknown traffic (tan)
- Noise (light gray)

The *strongest pilot trace display* contains the pilot dominance and multipath power parameters. Awareness of these two parameter values helps you be sure that you are making valid measurements on the sector of interest.

The *metrics display* shows 18 measurement parameters displayed below the trace display in three columns and six rows—each with a value and units. For more information about the metric display, refer to [“Metrics Provided by CDMA Over Air Measurements” on page 450](#).

The frequency indicator is at the bottom right corner of the screen, the time reference indicator at the bottom left. For each indicator the text indicates which reference you have chosen. A green LED indicates a locked condition. A red “X” indicates an unlocked condition.

Optional CDMA Over Air Measurement Settings

You can alter several optional measurement parameters in CDMA Over Air:

- “Setting the Channel or Frequency Step” on page 428
- “Setting the PN Increment” on page 429
- “Setting the Transmitter Reference Level” on page 429
- “Setting the Active Channel Threshold Level and Auto Threshold Level” on page 431
- “Resetting Amplifier Capacity and Traffic Metrics” on page 432
- “Setting Measurement Time” on page 432
- “Setting Quick Page Channel” on page 433
- “Setting Average, Sweep, and Restart” on page 435
- “Adding a Marker” on page 436
- “Setting the Pass/Fail Limits” on page 438
- “Metrics Provided by CDMA Over Air Measurements” on page 450
- “Interpretation of CDMA Over Air Measurement Results” on page 454

Setting the Channel or Frequency Step

You can set the channel or frequency step so you can quickly increment to the next channel or frequency using the Up Arrow and Down Arrow buttons.

Step	Notes
1 [Chan Step] or [Freq Step]	This choice depends on the [Units] mode you are using.
2 Enter the desired channel or frequency step using the numeric keypad.	
3 [Enter]	Notice (and verify) the number you entered below the Chan Step or Freq Step text on the corresponding button.

Setting the PN Increment

The PN Increment allows you to choose the increment step for the PN Offset. Typically the PN Increment is set to 1 when measuring CDMA transmitter performance while connected to the base station via RF cable.

The PN Increment field enables you to search based on a step size of your choice. If PN Increment = 1 (default), the search will step through PN values by one PN at a time. If PN Increment = 5, it will step through PN values 0, 5, 10, and so on. The Measured PN displayed will be a multiple of 5, even if the actual PN is not a multiple of 5. If you know that all base stations in the area have fixed increments, then set the PN Increment field to that increment value. If you don't know, then use the default value of 1.

Step	Notes
1. [PN Inc]	
2. Enter the PN Increment using the numeric keypad.	The maximum value you can enter is 15.
3. [Enter]	Notice (and verify) that the number you entered for your chosen PN Increment number appears below the PN Inc text on the corresponding button.

Setting the Transmitter Reference Level

You can set the CDMA transmitter reference level to display either relative power (dB) or absolute power (dBm). The test set defaults to relative. The top graticule (horizontal line) represents the total power in the CDMA channel. The scale per division is set to 5 dB per division.

If the reference level is set to relative, the reference level is relative to the total power (in dB) in the CDMA channel. If the reference level is set to absolute, the reference level displays the actual power (in dBm) in the CDMA channel.

Step	Notes
1 [Level/Location]	

Optional CDMA Over Air Measurement Settings

Step	Notes
2 On [Reference] select Abs or Rel.	Each time you press this softkey, the selected option changes.

Setting the Active Channel Threshold Level and Auto Threshold Level

The active channel threshold level is an advanced setting that can be set to indicate which code channels are considered active. Any code channels exceeding this power level are considered active traffic channels and any code channels below this power level are considered inactive (or noise). A horizontal red line on the screen represents the threshold level. The test set can set this level automatically, or you can manually enter a value.

In Auto mode the threshold level moves as the noise fluctuates. The threshold level is set by the test set at an optimal offset above the average noise floor. If you choose Auto mode, you can alter the auto threshold offset. The recommended and default setting is 0 dB. A negative value moves the threshold lower (closer to the noise floor) and is a more aggressive setting that increases the likelihood of interpreting an inactive channel as active. A positive value moves the threshold higher (away from the noise floor) and is a more conservative setting that increases the likelihood of interpreting an active channel as inactive.

In Manual mode the threshold level is fixed and does not move as the noise fluctuates.

To Set the Active Channel Threshold Level:

Step	Notes
1 [Setup]	
2 On [Thresh Lvl] select Auto or Manual .	Each time you press this softkey, the selected option changes. If you choose Manual, you must enter the threshold you want using the numeric keypad, then press [dB].
3 [Auto Thres Offset]	The default value is 0 dB. Optionally, you can enter a negative (more aggressive) or positive (more conservative) value, then press [dB].

Resetting Amplifier Capacity and Traffic Metrics

the amplifier capacity metrics such as the peak and average amplifier capacity and peak and average utilization can be reset. If you prefer to reset these parameters manually, you may do so using the [Reset Metrics] menu key. The test set may automatically reset these parameters for you if you are using the PN Offset Auto mode.

In PN Offset Auto mode, if the test set finds a new dominant pilot (from a stronger base station signal), the peak and average amplifier capacity values will be reset. The test set will decode the signal containing the new dominant pilot and gather new amplifier capacity data for this signal. In PN Offset Manual mode if the test set finds a new dominant pilot, the signal will not be decoded and the test set will display noise in the code domain power display. The amplifier capacity metrics will be unaffected and the test set will not gather data until the desired signal becomes dominant again.

To Manually Reset the Amplifier Capacity Metrics:

Step	Notes
1	[Reset/Display/Amp Cap]
2	[Reset Metrics]

Setting Measurement Time

The Measurement Time setting allows you to alter the speed at which measurements are being made. Three choices exist: Slow, Average, and Fast. The test set defaults to Average. Slow measurement time provides a more accurate measurement at the expense of time. Fast measurement time provides a quicker measurement at the expense of accuracy. Average measurement time strikes a balance between measurement speed and measurement accuracy.

Step	Notes
1	[Setup]
2	On [Meas Time] select Slow, Avg, or Fast. Each time you press this softkey, the selected option changes.

Setting Quick Page Channel

With the advent of cdma2000, a new control channel called the quick page channel (QPCH) has been added. The QPCH is used to improve standby time in the phone and may or may not be enabled. The QPCH is generally channel number 80. Note that the QPCH is a bursted channel. In other words, it is not on all the time. You may have to wait to see the QPCH show up on the trace. The Delta QPCH Power parameter on the metric display can help you determine the level of the QPCH. The QPCH is also a single-wide channel: it only occupies one of the 128 channels. The pilot, paging, and sync control channels are double-wide channels and occupy two of the 128 channels on the display.

CDMA Over Air
Optional CDMA Over Air Measurement Settings

To Set the QPCH:

Step	Notes
1 [Setup]	
2 On [Quick Page Channel] select Off or Ch 80 .	Each time you press this softkey, the selected option changes.

Setting Average, Sweep, and Restart

Setting the Sweep

You can select either continuous or single sweep. Continuous sweep provides repeated, ongoing measurements. Single sweep performs a single measurement that is repeated only when you push the Single button.

To set sweep:

Step	Notes
1 [Average/Sweep]	
2 [Continuous] or [Single]	Each time you press this softkey, the selected option changes.

Setting Averaging

You can choose to have averaging on or off and set the number of averages you want to take. Averaging only applies to the data, not the trace. You can select from the following types of averaging: When initialized, the Agilent E7495A/B defaults to running average:

- A running average computes the new result as the weighted sum of the last result and the new measurement. The last result is weighted by $(n - 1)/n$. The new result is weighted by $1/n$. Each new measurement produces a new result.

To set averaging:

Step	Notes
1 Set the number of averages.	
a. [Average/Sweep]	
b. [Average]	
c. Enter the number of averages using the numeric keypad.	
d. [Enter]	

CDMA Over Air

Optional CDMA Over Air Measurement Settings

Step	Notes
2	Set averaging On or Off. <ol style="list-style-type: none">[Average/Sweep][Averaging][Off] or [On]

NOTE

These two steps can be performed in any order. However, if you turn averaging on and a large number of averages has previously been set, there may be a delay before you can change number of averages.

Setting Restart

When you have averaging turned **On** and you are in **Continuous** Sweep mode, you can restart the averaging by pressing the Restart menu key. The Restart key has no effect if you are in **Single** sweep mode.

To restart averaging:

Step	Notes
1	[Average/Sweep]
2	[Restart] This key is unavailable or has no effect when Sweep is set to Single . To restart a Single Sweep measurement, press [Single].

Adding a Marker

Markers can be used on traces to help you visually track up to four signals. Each marker has the following settings:

- **Type:** Provides three options, including:
 - **Off**
 - **Normal**, which places a diamond-shaped, colored marker, along with a number, 1-4, on the trace.
 - **Delta**, is associated with a normal marker. Therefore, a normal marker must exist prior to creating the delta marker. The delta marker displays the

difference between the normal marker position and the delta marker position. Only one delta marker can be associated with a given normal marker. The normal marker must be active when Delta is selected.

- **Marker to Peak:** Places the active marker on the current greatest value of the trace.
- **Marker to Next Peak:** Places the active marker on the current second greatest value of the trace.

Step	Notes
1	[Marker]
2	[Marker]
3	[1], [2], [3], or [4]
4	[Type]
5	[Off], [Normal], or [Delta]
6	Locate the marker relative to the trace: <ul style="list-style-type: none">• [Marker to Peak] or• [Marker to Next Peak]

Setting the Pass/Fail Limits

The measurement limits settings enable you to alter the values of the test limits for the important measurements on the CDMA Over the Air Analyzer Screen. These settings affect the metrics color display: red represents fail, green represents pass. Next to the displayed measurement value, a (P) for Pass, or (F) for Fail, will be shown to further indicate whether the value is within or outside the set limits. In addition, the words “ALL PASS” or “FAILURE” are displayed in the bar at the bottom of the screen for all limits which have been turned on.

- **Frequency Limits:** Sets the high and low Frequency Error limits for the channel. Any measured frequency error that is outside of the set limits will result in a failure indication. The High limit is set by entering a positive number, and the Low limit is set by entering a negative number.
- **Time Offset Limits:** Sets the high and low time offset limits for the channel. Limits are set in microseconds. Any measured time offset value that is outside of the set limits will result in a failure indication.
- **Est. Rho Limit:** Sets the lower Estimated Rho limit for the channel. Any measured value of estimate Rho this is below the set limit will result in a failure indication.
- **Carrier Feedthrough Limit:** Sets the upper carrier feedthrough limit for the channel. The upper limit is set in dBc and is relative to channel power. Any measured carrier feedthrough value that is above the set limit will result in a failure indication.
- **Noise Floor Limit:** Sets the upper noise floor limits for the channel. The limit is set in dB and is absolute. Any measured noise floor value above the set limit will result in a failure indication.
- **Pilot Power Limit:** Sets the upper and lower limit of the delta page power. This limit is set in dBm. Any measured value that is above or below the set limit will result in a failure indication.
- **Delta Page Power Limits:** Sets the upper and lower limit of the delta page power. The limit is set in dB and is relative to the pilot power. The Delta Page Power Limit calculates a value relative to Carrier Power. If the calculated delta value exceeds the maximum or minimum set value, a failure is indicated.
- **Delta Sync Power Limits:** Sets the upper and lower limit of the delta sync power. The limit is set in dB and is relative to the pilot power. Any measured Delta Sync Power value above or below the set limit will result in a failure indication.

To Set the Measurement Frequency Error Limits:

Step	Notes
1	[Setup]
2	[Limits]
3	<p>On [Freq Error Limits] select On or Off.</p> <p>Enables you to toggle the measurement limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> • If set to On, the Frequency Error will change from blue to red (fail) or green (pass) and indicate either a “P” (pass) or “F” (fail). If the measured value exceed either the upper or lower limit, ALL PASS, in the bar at the bottom of the screen, will change to FAILURE. • If set to Off, the channel freq/number value will be displayed in blue. The area at the bottom of the screen that is used to indicate Pass or Fail will be over-written. The bar at the bottom of the screen, will indicate measurement in progress.
4	<p>Set the upper limit.</p> <ol style="list-style-type: none"> a. [High Limit] b. Enter the number on the numeric keypad. c. [GHz], [MHz], [kHz], or [Hz]
5	<p>Set the lower limit.</p> <ol style="list-style-type: none"> a. [Low Limit] b. Enter the number on the numeric keypad. c. [GHz], [MHz], [kHz], or [Hz]



CDMA Over Air
Optional CDMA Over Air Measurement Settings

To Set the Measurement Time Offset Limits:

Step	Notes
1 On [Time Offset Limits] select On or Off .	<p>Enables you to toggle the measurement limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none">• If set to On, the displayed time offset metrics will change from blue to red (fail) or green (pass) and indicate either a “P” (pass) or “F” (fail). If the measured values exceed the upper or lower limit, ALL PASS, in the bar at the bottom of the screen, will change to FAILURE.• If set to Off, the time offset value will be displayed in blue. The bar at the bottom of the screen will indicate measurement in progress.
2 Set the upper limit. a. [High Limit] b. Enter the number on the numeric keypad. c. [μ sec]	
3 Set the lower limit. a. [Low Limit] b. Enter the number on the numeric keypad. c. [μ sec]	

To Set the Measurement Estimated Rho Lower Limit:

Step	Notes
1	<p>On [Est. Rho Limit] select On or Off.</p> <p>Enables you to toggle the measurements lower limit function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> • If set to On, the displayed estimated Rho metrics will change from blue to red (fail) or green (pass) and indicate either a “P” (pass) or “F” (fail). If the measured values exceed lower limit, ALL PASS, in the bar at the bottom of the screen, will change to FAILURE. • If set to Off, the time estimated Rho value will be displayed in blue. The bar at the bottom of the screen will indicate measurement in progress.
2	<p>Set the lower limit.</p> <p style="padding-left: 20px;">a. [Low Limit]</p> <p style="padding-left: 20px;">b. Enter the number on the numeric keypad.</p> <p style="padding-left: 20px;">c. [Enter]</p>



CDMA Over Air
Optional CDMA Over Air Measurement Settings

To Set the Measurement Carrier Feedthrough Upper Limit:

Step	Notes
1 On [Carr Feed-thru Limit] select On or Off .	Enables you to toggle the measurement limits function On (active) and Off (inactive). <ul style="list-style-type: none">• If set to On, the displayed carrier feedthrough metric will change from blue to red (fail) or green (pass) and indicate either a “P” (pass) or “F” (fail). If the measured value exceeds the upper limit, the words ‘ALL PASS’, in the bar at the bottom of the screen, will change to ‘FAILURE’.• If set to Off, the time carrier feedthrough value will be displayed in blue. The bar at the bottom of the screen will indicate measurement in progress.
2 Set the upper limit. <ol style="list-style-type: none">[High Limit]Enter the number on the numeric keypad.[dBc]	Upper Limit range: 60 to –150 dBc

To Set the Measurement Noise Floor Upper Limit:

Step	Notes
1	<p>On [Noise Floor Limits] select On or Off.</p> <p>Enables you to toggle the measurement limit function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> • If set to On, the displayed noise floor metrics will change from blue to red (fail) or green (pass) and indicate either a “P” (pass) or “F” (fail). If the measured value exceeds the upper limit, the words ‘ALL PASS’, in the bar at the bottom of the screen, will change to ‘FAILURE’. • If set to Off, the time noise floor value will be displayed in blue. The bar at the bottom of the screen will indicate measurement in progress.
2	<p>Set the upper limit. Upper Limit range: 60 to –150 dBc</p> <ol style="list-style-type: none"> a. [High Limit] b. Enter the number on the numeric keypad. c. [dB]

CDMA Over Air
Optional CDMA Over Air Measurement Settings

To Set the Measurement Pilot Power Limits:

Step	Notes
1 On [Pilot Power Limits] select On or Off .	<p>Enables you to toggle the measurement limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none">• If set to On, the delta pilot power metrics will change from blue to red (fail) or green (pass) and indicate either a “P” (pass) or “F” (fail). If the measured value exceeds the upper limit or lower limit, the words ‘ALL PASS’, in the bar at the bottom of the screen, will change to ‘FAILURE’.• If set to Off, the time pilot power value will be displayed in blue. If NO limits are set to On, the pass/fail bar will not be displayed at the bottom of the screen.
2 Set the upper limit. a. [High Limit] b. Enter the number on the numeric keypad. c. [dBm]	Delta Limit range: –150 to 100 dBm
3 Set the lower limit. a. [Low Limit] b. Enter the number on the numeric keypad. c. [dBm]	Delta Limit range: –150 to 100 dBm

To Set the Measurement Delta Page Power Limits:

Step	Notes
1	<p>On [Δ Page Pwr Limits] select On or Off.</p> <p>Enables you to toggle the measurement limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none"> • If set to On, the delta page power metrics will change from blue to red (fail) or green (pass) and indicate either a “P” (pass) or “F” (fail). If the measured value exceeds the upper limit or lower limit, the words ‘ALL PASS’, in the bar at the bottom of the screen, will change to ‘FAILURE’. • If set to Off, the time delta page power value will be displayed in blue. If NO limits are set to On, the pass/fail bar will not be displayed at the bottom of the screen.
2	<p>Set the upper delta limit. Delta Limit range: –150 to 100 dB</p> <ol style="list-style-type: none"> a. [High Limit] b. Enter the number on the numeric keypad. c. [dB]
3	<p>Set the lower delta limit. Delta Limit range: –150 to 100 dB</p> <ol style="list-style-type: none"> a. [Low Limit] b. Enter the number on the numeric keypad. c. [dB]

CDMA Over Air

Optional CDMA Over Air Measurement Settings

To Set the Measurement Delta Sync Power Limits:

Step	Notes
1 On [Δ Sync Pwr Limits] select On or Off .	<p>Enables you to toggle the measurement limits function On (active) and Off (inactive).</p> <ul style="list-style-type: none">• If set to On, the delta sync. power metrics will change from blue to red (fail) or green (pass) and indicate either a “P” (pass) or “F” (fail). If the measured value exceeds the upper limit or lower limit, the words ‘ALL PASS’, in the bar at the bottom of the screen, will change to ‘FAILURE’.• If set to Off, the time delta sync. power value will be displayed in blue. If NO limits are set to On, the pass/fail bar will not be displayed at the bottom of the screen.
2 Set the upper delta limit.	Delta Limit range: –150 to 100 dB
a. [High Limit]	
b. Enter the number on the numeric keypad.	
c. [dB]	
2 Set the lower delta limit.	Delta Limit range: –150 to 100 dB
a. [Low Limit]	
b. Enter the number on the numeric keypad.	
c. [dB]	

Setting Up the Signal Generator

You can set up the signal generator while in the Spectrum Analyzer mode from the Setup menu. For more detailed information on the signal generator setup and operation, refer to [“Using the Signal Generator” on page 200](#)

CAUTION

The maximum power for the RF In and RF Out/SWR port is 20 dBm (100 mW). The maximum power for the Power Sensor port is 24 dBm (300 mW). When directly coupled to a base station, the test set can be damaged by excessive power applied to any of these three ports.

To prevent damage in most situations when you directly couple the test set to a base station, use the high power attenuator between the test set and the BTS.

NOTE

The lowest level the signal generator can go to is -90 dBm. In order to get a lower level, you must use an external attenuator. You can compensate for the attenuator in the RF Out Loss.

Step	Notes
1 [Setup]	
2 [Sig Gen]	
3 [Freq/Chan]	
4 [Frequency] or [Channel]	
5 Enter the channel or frequency using the numeric keypad.	
6	<ul style="list-style-type: none"> • For channel select [Rev] or [Fwd] • For frequency select [GHz], [MHz], [kHz], or [Hz],
7 [Mod Format]	

CDMA Over Air
Optional CDMA Over Air Measurement Settings

Step	Notes	
8	Select the channel standard from the list using the up and down arrow buttons.	
9	[Select]	
10	Set the RF output amplitude a. [Amplitude] b. Enter the amplitude value using the numeric keypad. c. [dBm].	You may also enter a new value for amplitude by turning the rotary knob until the desired value is displayed or using the up and down arrow keys.
11	If you have previously stored RF Out Loss from an insertion loss measurement, go to the next step. Or Press [RF OUT Loss] to select On and enter the RF Out Loss value.	For information on the effects of the RF Out Loss function on the amplitude, refer to “Using the RF OUT Loss field,” below. Each time you press this softkey, the selected option changes.
12	Connect to the base station.	
13	Set [Enable Sig Gen] to Yes .	Each time you press this softkey, the selected option changes.
14	Set [RF] to On .	

Using the RF OUT Loss field

The RF OUT Loss field is used when it is necessary to test the receiver sensitivity of a typical base station. The test set’s source will typically go down to –95 dBm, in order to reach –113 dBm for sensitivity testing, you must use an external pad. The measured value of the pad and connecting cables are entered into this field. This value is then used when this field is set to **On**. When this field is set to **On**, the test set will set the RF generator level to the correct level offset by the external pad/cabling. When you set the RF Generator to –113 dBm (with the RF OUT Loss field turned **On** and the external pad/cabling loss value entered) the output at the end

of the RF test cabling is -113 dBm.

Example: If you want to set the signal generator to -113 dBm, the pad and RF cabling measures 42.51 dB (measured with the 2 port insertion loss measurement screen prior to this test), the RF OUT Loss field is turned **On** (with the 42.51 dB loss value entered). The actual RF output of the signal generator is -70.49 dBm, the pad and RF cabling attenuated the signal to the desired level; so the RF signal at the end of the test cable/pad is -113 dBm. This also points out the importance of accurately measuring the loss of the pad and connecting cables.

Metrics Provided by CDMA Over Air Measurements

This section contains descriptions of the individual CDMA transmit parameters in the metric display of the screen. “[Interpretation of CDMA Over Air Measurement Results](#)” on page 454 contains expected result values and possible causes of error if the expected results are not met.

Frequency Error

Frequency error is the frequency difference between your transmitter's actual center frequency and the frequency (or channel) you entered.

PN Offset

The PN Offset is a “short code” sequence that provides a unique identifier for each sector of each cell site. The PN Offsets are applied to the I and Q signals before modulation. PN Offsets are offset in time by 52.08 μs and they repeat every 26.666 ms. This yields 512 unique short code sequences (0-511). The mobile phone needs the PN Offset to decode information in the Sync and Paging channels, which are transmitted by the base station.

Time Offset

The Time Offset compares the PN Offset timing with the overall system time. This measurement checks the start of the PN offset in comparison to either the GPS signal or the Even Second clock signal. For example, PN Offset 0 should repeat exactly on the rising edge of the Even Second clock. PN Offset 1 should repeat 52.08 μs after the rising edge of the Even Second clock, and so forth. Any error in time from that event is reported as a Time Offset.

IS-95 specifies that the base station timing must be within $\pm 10 \mu\text{s}$ of its assigned value. Many base station manufactures specify that the timing must be within $\pm 3 \mu\text{s}$. For example, if you are parked near the transmit antenna, the propagation delay is less than 1 μs . The measured value of delay should be within the recommended limit, which is greater than $-10 \mu\text{s}$ and less than $+10 \mu\text{s}$. As you move away from the transmit antenna, propagation delay needs to be considered—about 1 μs for every 300 meters (1000 feet). So, if you are parked 800 meters ($\frac{1}{2}$ mile) from the transmit antenna, the additional propagation delay would be approximately 2.5 μs . The measured value of delay should be greater than $-7.5 \mu\text{s}$ and less than $+12.5 \mu\text{s}$.

Metrics Provided by CDMA Over Air Measurements

Below is a table showing various delays vs. distance.

Distance	Delay
161 meters (0.1 mile)	0.56 μ s
402 meters (0.25 mile)	1.36 μ s
805 meters (0.5 mile)	2.72 μ s
1609 meters (1 mile)	5.28 μ s
8047 meters (5 miles)	26.4 μ s

Estimated Rho

Estimated Rho is the measure of the modulation quality for a CDMA transmitter. This measurement is analogous to measuring FM accuracy and distortion in an AMPS network or EVM in a TDMA system. A Rho value of 1.0 is perfect, indicating that all of the power is being transmitted correctly.

Carrier Feedthrough

Carrier Feedthrough is a result of the RF carrier signal feeding through the I/Q modulator and appearing at the transmitter port. Carrier Feedthrough is a common cause of bad Rho measurements.

Noise Floor

Noise Floor is the average power of all the inactive channels.

Channel Power

Channel Power is the total power within a defined bandwidth. For CDMA the channel bandwidth is defined to be 1.25 MHz. Channel Power measures the power the base station is transmitting across the entire 1.25 MHz CDMA channel.

Pilot Power

Pilot Power is the total power in the Pilot code channel, expressed in dBm. The transmit power of the Pilot Channel signal for a given base station is constant.

Pilot Ec/Io

The Pilot Ec/Io is the ratio of the pilot power to all the other power in the channel, expressed in dB. Since Ec and Io are measured individually, the system can detect poor signal quality and tell you if it is caused by low Ec or high Io. This helps you quickly resolve coverage versus interference issues.

Delta Page Power

Delta Page Power is the amplitude difference between the Paging Channel and Pilot Channel, expressed in dB. The transmit power of the Paging Channel is constant and can be set at a value relative to the Pilot Power. A common value is -4 dB relative to the Pilot. It is important to know what the intended settings are for each carrier and sector of your base station.

Delta Sync Power

Delta Sync Power is the amplitude difference between the Sync Channel and Pilot Channel, expressed in dB. The transmit power of the Sync Channel is constant and may be set at a value relative to the Pilot Power. A common value is -10 dB relative to the Pilot. It is important to know what the intended settings are for each carrier and sector of your base station.

Delta Quick Page Channel Power

Delta Quick Page Channel (QPCH) Power is the amplitude difference between the Quick Page Channel and Pilot Channel, expressed in dB. The QPCH is a bursted channel and is not on all the time. In order to capture the level of the QPCH, the statistic measures and holds the peak level of the QPCH. Until a QPCH has been measured, the value will be dashes. When “on”, the level of the QPCH is constant and is set at a value relative to the Pilot Power. The QPCH digital gain level can be set to 2, 1, 0, -1, -2, -3, -4, and -5 dB relative to the Pilot. It is important to know what the intended settings are for each carrier and sector of your base station.

Amplifier Capacity

Assuming the Amplifier Capacity parameters are set properly, the Amplifier Capacity measurement is an estimate of the amount of power amplifier capacity that is being used, expressed in percent of maximum. When an amplifier is transmitting at maximum output power, it is said to be at 100% of its capacity. For example, an amplifier with a maximum output power of 12 watts would be at 50% of capacity when transmitting 6 watts and at 100% of capacity when transmitting at 12 watts.

The percentage of amplifier capacity increases as the number or level of the traffic channels increase.

Peak Amplifier Capacity

Peak Amplifier Capacity is the peak level of all the valid Amplifier Capacity measurements while on the same PN offset. In PN Offset Auto mode this measurement is reset if the PN offset changes or the Reset Metrics button is used. In PN Offset Manual mode this measurement is reset only if the Reset Metrics button is used.

Average Amplifier Capacity

Average Amplifier Capacity is the average level of all the valid Amplifier Capacity measurements while on the same PN offset. In PN Offset Auto mode this measurement is reset if the PN offset changes or the Reset Metrics button is used. In PN Offset Manual mode this measurement is reset only if the Reset Metrics button is used.

Utilization

Utilization is a ratio of the active Walsh codes to the total 128 Walsh codes, expressed in percent. Even though active control channels such as the pilot are included in the utilization measurement, utilization is an indication of the traffic that is being carried by the base station.

For example, a CDMA signal with a pilot, paging, and sync channel, two IS-95 traffic channels, and one eight-wide cdma2000 data channel, would use 18 Walsh codes. Each control channel would use two Walsh codes, each IS-95 channel would use two Walsh codes, and the cdma2000 channel would use 8 Walsh codes for a total of 18 Walsh codes. Eighteen Walsh codes in use out of the 128 total Walsh codes would result in a utilization of 14%.

Peak Utilization

Peak Utilization is the peak level of all the valid Utilization measurements while on the same PN offset. In PN Offset Auto mode this measurement is reset if the PN offset changes or the Reset Metrics button is used. In PN Offset Manual mode this measurement is reset only if the Reset Metrics button is used.

Average Utilization

Average Utilization is the average level of all the valid Utilization measurements while on the same PN offset. In PN Offset Auto mode this measurement is reset if the PN offset changes or the Reset Metrics button is used. In PN Offset Manual mode this measurement is reset only if the Reset Metrics button is used.

Interpretation of CDMA Over Air Measurement Results

This section contains expected result values and possible causes of error if the expected results are not met.

Frequency Error

The standards specify very tight Frequency Error performance. In the PCS bands, the 0.05 parts-per-million specification translates to only 99 Hz at a carrier frequency of 1980 MHz or 40 Hz at 850 MHz cellular frequencies. Frequency Error shows up as uncorrelated power that adds to the noise floor or shows up in other Walsh codes.

If a particular site loses its reference to GPS time, its reference signals will begin to drift over time. Mobiles already using the site can remain on the air because they derive their timing from the signals transmitted by the base station. However, mobiles using other sites/sectors may be prevented from using the site because they are confused by the error in frequency. This creates what is known as the “island cell effect”. By itself, the cell is still functional. To the rest of the system, it's inaccessible.

This island cell effect can be caused by a failure in the site's GPS receiver and timebase distribution network. Using the test set's Internal GPS receiver provides an independent time reference that will allow you to determine if this cell site is out of sync with the rest of the network (“island cell effect”).

PN Offset

Verify the PN Offset is correct. If you are in Manual mode, the PN Offset will display the value you entered. Make sure the Time Offset is small (less than 3 μ s). If the Time Offset is greater than expected, see the section on Time Offset below. If you are in Auto mode, the test set will tune to the PN Offset with the least amount of Time Offset. If an incorrect PN Offset is displayed, the Time Offset will likely be very large.

Time Offset

The CDMA standards specify a maximum offset of 10 μ s; generally 5 μ s is a recommended maximum. If the Time Offset is large enough, an “island cell” can occur. The “island cell effect” was mentioned already when discussing Frequency Error.

A phone moving outward toward the limit of its cell will need to acquire the

Interpretation of CDMA Over Air Measurement Results

adjacent cell in order to hand off. If the time offset of the target cell is too far from that of the current site, the handoff may not happen.

The dependence of the phone on correct system time limits the physical distance to a target cell's antenna. Each PN Offset is 52.08 μ s; if the propagation delay is too long, the received PN Offset may be different from the value designated on the Sync channel. This difference can confuse the phone, causing the handoff to fail.

Another cause of timing error is a bad GPS receiver or timing distribution network within the base station. To test your base station's GPS and timing distribution system, you can use the internal GPS receiver to generate an accurate timing reference for the test set to use while performing base station tests.

The Time Offset should be within the following limits:

- Less than +/- 10 μ s if the receiving antenna is next to the base station, or
- Less than +/- 10 μ s, plus 1 μ s for every 300 meters (1000 feet) you are away from the base station.

If the measured value of the Delay falls outside of the expected range, consider the following problems:

- The GPS receiver is not working correctly, and the base station timing is incorrect.
- The base station main oscillator is not working correctly, and the base station timing is incorrect.
- The GPS receiver is not locked to the GPS satellites.

Estimated Rho

The CDMA base station standard specifies that Rho must be greater than 0.912. Typical values for a healthy base station are greater than 0.94. When measuring Rho over-the-air, these values can only be achieved under very good conditions for multipath power and pilot dominance. For example, a Multipath Power of < 0.1 dB and a Pilot Dominance of > 15 dB is required to measure Rho of 0.912. For more on the affects of pilot dominance and multipath power on Estimated Rho see [“Criteria for Making Valid CDMA Over Air Measurements” on page 421.](#)

Verify that the Estimated Rho meets the following criteria:

- Greater than 0.8 if the Multipath Power and Pilot Dominance properties remain at the defaults of 0.4 dB and 10 dB, respectively, or
- Greater than 0.912 if you have set the Multipath Power and Pilot Dominance properties to 0.1 dB and 15 dB, respectively.

Poor Rho performance affects the base station capacity because the uncorrelated power appears as interference to the mobiles. The added interference will require an increase in the traffic channel level to overcome the interference. This may, in turn, be seen as further interference. At some point, the site will have to shed calls in order to supply the remaining calls with enough signal versus the interference in the system.

If Estimated Rho is lower than expected, check the following:

- External interference may be degrading the CDMA signal. Use the spectrum analyzer to verify that no spurious signals are present in the band of the transmitter.
- Compression may be occurring in the base station power amplifier.
- There may be errors in the base station IQ modulator.

Carrier Feedthrough

A good Carrier Feedthrough level is less than -25 dB. The IS-97 standard does not specify Carrier Feedthrough; however, this measurement provides an additional tool to troubleshoot the base station's transmitter.

In the frequency domain, Carrier Feedthrough can show up as an uncorrelated energy spike that can be seen on the spectrum analyzer by closely spanning into the top of the CDMA signal. The effects of Carrier Feedthrough can also show up as higher noise levels on the Code Domain Power screen. The inactive Walsh codes will be pushing the -27 dB specification for noise. Carrier Feedthrough can be caused by the lack of isolation across the mixer and cavity of the transmitter's I/Q modulator.

Noise Floor

A good Noise Floor value is between -20 dB and -30 dB and depends on the quality of the signal. If the Noise Floor is above these values (for example, -20 dB), the modulator may be the source of the added noise. Another possibility is a problem with the base station's channel card. The channel card generates the individual Walsh codes.

Channel Power

If the Channel Power is lower than expected, verify you are in a location that meets the criteria to provide valid measurements.

Inaccurate Channel Power (high or low) may indicate an incorrect power setting at the base station.

Pilot Power

If the Pilot Power has varied significantly from previous readings at the same location, it may indicate the following:

- There has been a change made to the digital gain setting of the Pilot Channel.
- The base station power amplifier has a problem.
- The transmit antenna system has been changed or damaged.

Pilot Ec/Io

A high value of Ec/Io means there is less interference from other base stations and noise and is an indicator of base station performance. When Ec/Io is mapped, it can be used to determine coverage quality.

Delta Page Power

If the measured value of Delta Page Power is more than +/-0.5 dB different from previous measurements at the same location, it may indicate that the digital gain setting for the Paging Channel has been changed from the intended setting.

Delta Sync Power

If the measured value of Delta Sync Power is more than +/- 0.5 dB different from previous measurements at the same location, it may indicate that the digital gain setting for the Sync Channel has been changed from the intended setting.

Delta Quick Page Channel Power

If the measured value of Delta QPCH Power is more than +/-0.5 dB different from previous measurements at the same location, it may indicate that the digital gain setting for the QPCH has been changed from the intended setting.

Amplifier Capacity

The Amplifier Capacity metric provides an instantaneous reading of how much of the amplifier's capacity is currently being used. More meaningful information is provided by the Peak and Average Amplifier Capacity metrics gathered over a 10 to 15 minute interval.

Peak Amplifier Capacity

If the Peak Amplifier Capacity is greater than 100%, the traffic at this base station has caused the base station amplifier to exceed its maximum power rating. This is not desirable as this problem can result in system degradation or damage to the

amplifier.

You can get an indication of how often the amplifier capacity is being exceeded by watching the Amplifier Capacity measurement. This is an instantaneous measurement of the amplifier capacity.

Average Amplifier Capacity

If the Average Amplifier Capacity is greater than 85%, the base station power amplifier is close to its maximum power limit. Further increase in traffic on this base station could cause system performance problems or damage to the power amplifier. You should notify your RF Engineering Department as soon as possible.

Utilization

The Utilization metric provides an instantaneous reading of the percentage of the traffic channels currently being used. More meaningful information is provided by the Peak and Average Utilization metrics gathered over a 10 to 15 minute interval.

Peak Utilization

If the Peak Utilization of this base station is greater than 65%, this is a warning that peak traffic rates at this base station are getting very high. It is possible that calls could be getting blocked or dropped.

Average Utilization

If the Average Utilization of this base station is greater than 45%, the base station is carrying a great deal of traffic. It may be time to consider adding another carrier or another base station.

- “Using the W-CDMA Over the Air Tool” on page 460
- “Preparing to Make W-CDMA Over the Air Measurements” on page 460
- “Criteria for Making Valid W-CDMA Over the Air Measurements” on page 460
- “Performing a Basic W-CDMA Over the Air Measurement” on page 462
- “Displaying Location Information Using GPS” on page 464
- “Setting Amplifier Capacity Metrics” on page 465
- “Multiple-View Display” on page 466
- “Setting Multiple-View Options” on page 470
- “Codogram Display” on page 471
- “Setting Codogram Display Options” on page 473
- “Setting the Channel or Frequency Step” on page 475
- “Setting the Scrambling Codes” on page 476
- “Setting the Transmitter Reference” on page 476
- “Setting Average, Sweep, and Restart” on page 478
- “Setting the Active Channel Threshold Level and Auto Threshold Offset” on page 480
- “Resetting Amplifier Capacity and Traffic Metrics” on page 480
- “Setting Measurement Time” on page 481
- “Setting Valid Measurement Limits” on page 481
- “Setting the S-CCPCH Parameters” on page 482
- “Setting the PICH Parameters” on page 483
- “Adding a Marker” on page 484
- “Metrics Provided by the W-CDMA Analyzer Measurement” on page 486
- “Interpretation of W-CDMA Over the Air Measurement Results” on page 489

Using the W-CDMA Over the Air Tool

W-CDMA over the air measurements provide a quick method of verifying W-CDMA transmitter performance. These transmitter measurements can be made on a base station (node B) from the convenience of your vehicle without taking the base station out of service. Over the air measurements are especially useful in maintaining hard-to-access cell sites such as pole top base stations. The W-CDMA Over the Air option may also be used to measure signals at a coupled port on the transmitter.

For out-of-service W-CDMA transmitter measurements, the W-CDMA Tx Analyzer option is recommended. For more information refer to [“W-CDMA Analyzer” on page 329](#).

CAUTION

To achieve valid over-the-air measurements, the test set must be stationary (not moving). An alternative is to make these measurements from a coupled port at the base station.

Preparing to Make W-CDMA Over the Air Measurements

An important consideration when making W-CDMA over the air measurements is your location relative to the base station. There must be no obstructions between your location and the base station antennas. Also, the GPS antenna must be able to “see” the satellites to obtain lock. You must know the channel or frequency and the Channel Standard of the W-CDMA signal to be analyzed.

Once you have connected the proper antenna and filter to the test set, chosen a stationary location, and verified that you have a clear view of the base station antennas, you can perform W-CDMA over the air measurements.

If this is the first W-CDMA over the air measurement for this base station, you must find a location that meets the criteria for making a valid measurement. Your location must have a dominant pilot and very low multipath power. If you have made W-CDMA over the air measurements at this location before and know it provides valid measurements, skip to [“Performing a Basic W-CDMA Over the Air Measurement” on page 462](#).

Criteria for Making Valid W-CDMA Over the Air Measurements

The first step in making valid W-CDMA over the air measurements is to identify a target base station to measure. Then, for your measurements to be valid, you must

find a location near the target base station with an unobstructed view of the base station antenna and a sufficiently strong W-CDMA signal. W-CDMA over the air measurements will experience interference from other W-CDMA signals on the same RF channel and from multipath echoes. The code domain power view measures two key parameters to indicate these effects:

- Pilot dominance—The difference between the energy of the strongest pilot channel and the combined energy in the second and third strongest pilot channels (expressed in dB). Ideally, this value should be very large (> 16 dB)
- Multipath power—The amount of power, of the dominant pilot signal, that is dispersed outside the main correlation peak due to multipath echoes (expressed in dB). Ideally, this value should be very small (< 0.1 dB). **Multipath power** is the result of portions of the original broadcast signal arriving at the receiving antenna out of phase with the main power of the original signal. This can be caused by the signal being reflected off objects, such as buildings, or being refracted through the atmosphere differently from the main signal. These out of phase signals can cancel power from the main signal, or can appear as noise interference at the receiver.

The table below shows the quality of the over the air code domain measurements with respect to pilot dominance and multipath power.

Measurement Quality	Pilot Dominance	Multipath Power
Very good	> 16 dB	< 0.1 dB
Fair	> 10 dB	< 0.4 dB
Marginal	> 8 dB	< 0.7 dB

The default measurement limits for pilot dominance and multipath power are set to give “fair” measurement quality. If these limits are met, the pilot dominance and multipath power values will be displayed in green. When the pilot dominance and multipath power parameters are outside the acceptable limits, the parameters will turn red. If this occurs, you must move to a different location that meets the “fair” criteria defined above.

In general, you should always use a preselector filter for the band of interest to prevent strong signals from overwhelming the signal of interest. Agilent offers the following preselector and antenna:

- Option 813—W-CDMA preselector filter and antenna for W-CDMA:

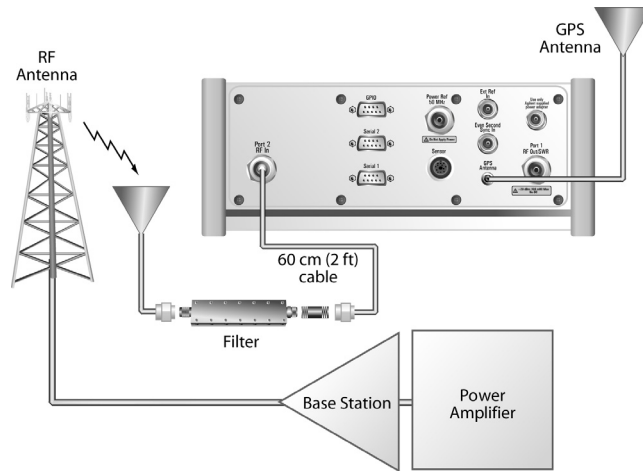
Performing a Basic W-CDMA Over the Air Measurement

Step	Notes	
1	Mode	
2	[Over the Air]	
3	[W-CDMA Over the Air]	
4	[Chan Std]	
5	Select the channel standard you want using the up and down arrow buttons.	
6	[Select]	
7	On [Units] select Chan or Freq .	Each time you press this softkey, the selected option changes.
8	[Channel] or [Frequency]	<ul style="list-style-type: none">• If you selected Chan in the previous step, select [Channel].• If you selected Freq, select [Frequency].
9	Enter the channel or frequency using the numeric keypad.	
10	[Fwd]	Selects the forward W-CDMA channel.
11	Verify that on [Fr/Time Ref] GPS is selected. If not, press [Fr/Time Ref], then press [GPS].	This step is not required but it can improve the accuracy of the test set frequency reference.
12	On [Scramble Code] select Auto or Manual .	The test set defaults to Auto mode. <ul style="list-style-type: none">• In Auto mode the test set finds the Scramble code of the strongest pilot signal and displays the value in the metrics display.• In Manual mode you must enter the Scramble code using the numeric keypad.

Step	Notes
13 [Level/Location]	
14 On [Ref Level] select Abs or Rel .	<p>Enables you to toggle the measurement reference value between Abs (absolute) and Rel (relative).</p> <ul style="list-style-type: none">• If set to Abs, the measurement is made in reference to absolute power and the results in the CDP chart are displayed in dBm.• If set to Rel, the measurement is made relative to a Channel Power and the results are displayed in dB.
15 [RF IN Loss]	
16 Enter the RF In Loss using the numeric keypad.	<p>If you are using a cable and additional devices connected to the antenna, enter the combined cable and device RF In Loss here. The RF In Loss can be obtained by measuring the Insertion loss. See “Two Port Insertion Loss” on page 55.</p> <p>Note: If data had been previously entered in [RF IN Loss], that data will be lost and replaced by the value you enter here.</p>
17 [dB]	
18 Connect to the antenna.	

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Step	Notes
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NOTE

The test set does not record data for post-processing. It provides a snapshot of W-CDMA base station transmit parameters at that location.

NOTE

During a W-CDMA over the air measurement, a yellow triangle symbol may temporarily appear beside “GPS” in the lower right. The yellow triangle indicates that the test set is re-synching with the GPS pulse per second signal. Once the test set is synched, a green dot appears in place of the triangle. If the GPS is unavailable, a red X appears.

Displaying Location Information Using GPS

If you are making W-CDMA over the air measurements at a location you previously established as valid, Agilent recommends using GPS to verify that you are at the location from which you previously measured.

If you are making W-CDMA over the air measurements from a new location, once you validate that the location provides a dominant pilot and low multipath power, Agilent recommends that you record the latitude and longitude coordinates of this location using GPS. Later measurements should be made from this precise location

to provide performance trends.

To Display GPS Location Information:

Step	Notes
1 [Level/Location]	
2 On [GPS Location] select On .	<p>Displays GPS satellite location information. Uses the internal GPS to capture the location of a measurement. These coordinates can be used to return to the same location to compare and contrast reference measurements to future measurements. The Time Ref (Freq/Chan/Time Ref mode) button must be set to Internal GPS for this function to be active. Information logged includes longitude, latitude, altitude (feet/meters), and the number of satellites tracked.</p> <p>Each time you press this softkey, the selected option changes.</p>
3 Highlight On	Toggle to On to display GPS satellite location information. Toggle to Off to remove the location information

NOTE

If you prefer to have an electronic copy of the location information, see [“Saving Data” on page 503](#).

Setting Amplifier Capacity Metrics

The Amplifier Capacity measurement is an estimate of the amount of power amplifier capacity that is being used, expressed in percent of maximum. Amplifier capacity properties must be properly set to make valid amplifier capacity measurements. Amplifier capacity metrics are amplifier capacity, peak amplifier capacity, and average amplifier capacity.

A W-CDMA base station is typically set up with a specified amount of power allocated to the CPICH (Common Pilot Channel), and the specified power settings of the PCCPCH (Primary Common Control Physical Channel) are defined relative to the CPICH. Occasionally, the PCCPCH power setting will also be specified in

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absolute power units (watts or dBm). Given the CPICH and PCCPCH setup values and the maximum power output of the amplifier, the percentage amplifier capacity setup parameters can be determined.

To Set Amplifier Capacity Properties:

Step	Notes
1 [Setup]	
2 [Amp Cap Settings]	
3 On [Amp Cap] select On .	
4 [CPICH Pwr]	CPICH refers to Common Pilot Channel.
5 Enter the CPICH power in watts, using the numeric keypad.	The CPICH power is the total power in the dominant pilot signal, expressed in watts.
6 [W]	
7 [Max PA Pwr]	
8 Enter the maximum power amplifier power in watts, using the numeric keypad.	A base station power amplifier is specified to have a maximum power limit.
9 [W]	
10 [Delta PCCPCH Pwr]	PCCPCH refers to Primary Common Control Physical Channel.
11 Enter the Delta PCCPCH Pwr in dB, using the numeric keypad.	The delta PCCPCH is the expected amplitude difference between the PCCPCH channel and CPICH channel, expressed in dB.
12 [dB]	

Multiple-View Display

The W-CDMA Tx analyzer multiple-view screen is divided into 4 sections in the Zoom view (default—[Figure 18-1 on page 469](#)) and 5 sections in the Full view ([Figure 18-2 on page 470](#)) as follows:

- **Zoom view:** The top-left graph (Code Domain Trace View) shows the power in

all 512 OVSF (Orthogonal Variable rate Spread Factor) Code Channels. Code channels have variable width depending on the Spread Factor for the channel. SF512 has 512 code channels with each channel 1 unit in width. SF256 has 256 channels with each channel 2 units in width. The width continues to double for SF128, SF64, and so forth. The Y-axis labels display the relative power (dB) or absolute power (dBm), threshold level, and dB/division. The X-axis labels display active channel numbers.

The light blue section on the bottom bar corresponds with the section displayed in zoom view (described below). The red line across the graph represents the active channel threshold. The control channels are in the color indicated in [“Control Channels Acronyms”](#). Active code channels shown on the display include:

- Active Traffic Channels (orange)
- Unknown Channels (tan)
- Noise (light gray)
- **Full view:** The top-left graph (Code Domain Trace View) shows the power in the first half of the OVSF channels (SF512 channels 0 - 255). The lower-left graph shows the power in the other half of the channels (SF512 channels 256-511). The code channel appearance and colors are the same as described above.
- **Zoom view:** The lower-left graph (Zoom View) shows the power in the section of the graph highlighted in light blue in the top-left graph, a section of 32, 64, or 128 codes.
- **Zoom and Full views:** The top-right graph (Strongest Pilot View) contains the pilot dominance and multipath power parameters. This shows the strongest Scrambling Codes seen by the test set. The Scrambling Code of interest should be clearly dominate. The display is useful when positioning the test set to see what other base stations or sectors need to be avoided. Awareness of these two parameter values helps you be sure that you are making valid measurements on the sector of interest.
- **Full view:** The lower-right graph (Control View) shows the power in the control channels (see [“Control Channels Acronyms”](#)). The delta power (relative to CPICH) is shown in the middle of the control bars.
- **Zoom and Full views:** The bottom portion (Metrics View) displays 15 measurement parameters for the current measurement, displayed in three columns and five rows—each with a value and units. For more information about the metric display, refer to [“Metrics Provided by the W-CDMA Analyzer Measurement”](#) on page 486.

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The frequency indicator is at the bottom right corner of the screen, the time reference indicator at the bottom left. For each indicator the text indicates which reference you have chosen. A green LED indicates a locked condition. A red “X” indicates an unlocked condition.

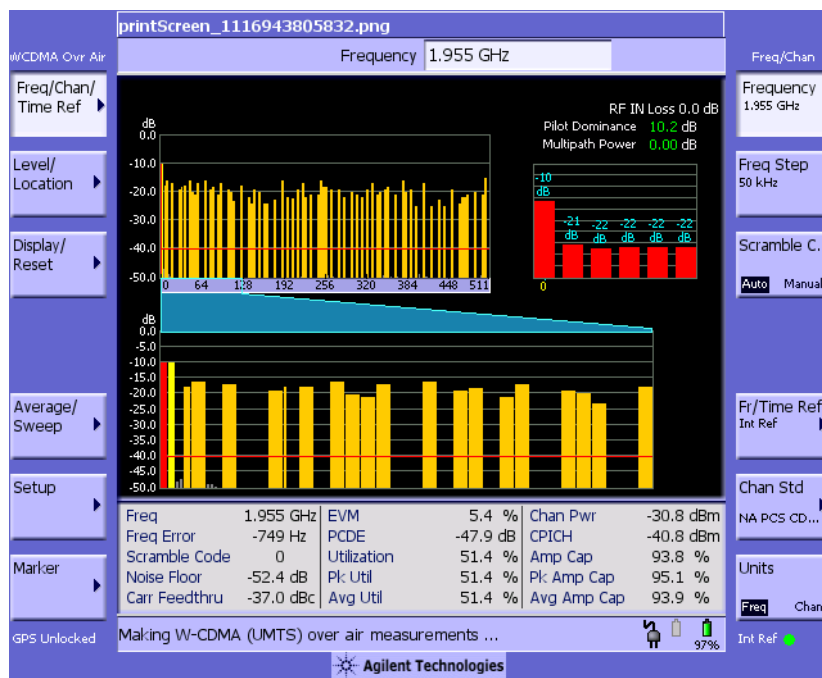
NOTE

In W-CDMA, the PSCH and SSCH are not assigned OVSF codes and therefore do not appear in the code domain trace view. The E7495A/B features a control channel graph view (Control View) for these two Sync channels to measure power only, since there are no OVSF codes associated with these channels. They have special non-orthogonal codes and are only **On** 10% of the time

Table 18-1 Control Channels Acronyms

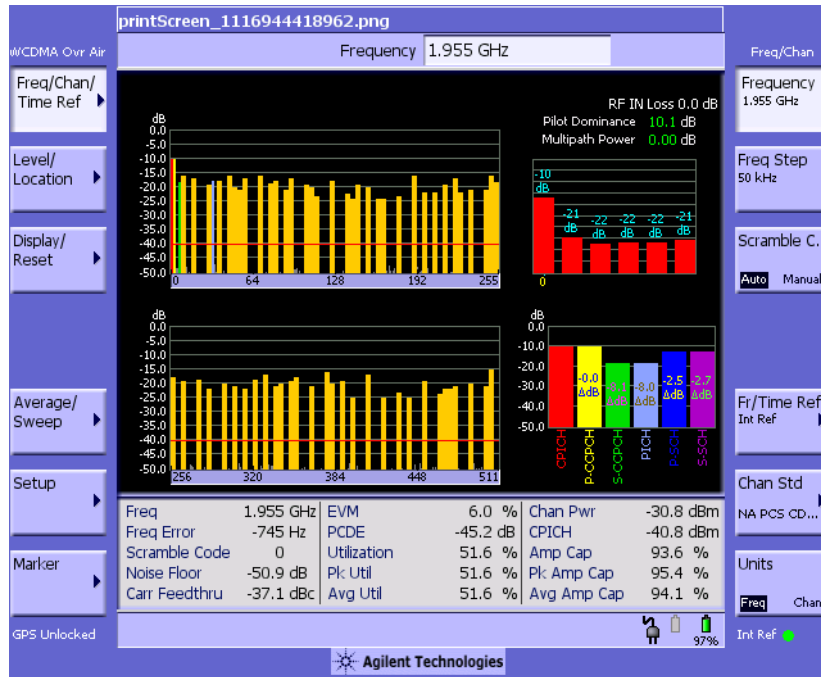
Acronym	Full Name	Viewable in Which Display Area
CPICH	Common Pilot Channel	Visible in all views (red bar)
PCCPCH	Primary Common Control Physical Channel	Visible in all views (yellow bar)
SCCPCH	Secondary Common Control Physical Channel	Visible in all views (green bar)
PICH	Paging Indicator Channel	Visible in all views (light blue bar)
PSCH	Primary Sync Channel	Visible ONLY in the Control View (blue bar)
SSCH	Secondary Sync Channel	Visible ONLY in the Control View (purple bar)

Figure 18-1 The Multiple-View Zoom Display



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Figure 18-2 The Multiple-View Full Display



Setting Multiple-View Options

The display options enable you to zoom in on portions of the graph, or to see the entire trace at once.

Step	Notes
1 [Display]	
2 On [View] select [Zoom] or [Full].	If you are displaying Zoom view and select Full view, the display changes the top-left and bottom-left graphs to show the first 256 codes in the top graph, and the second 256 codes in the bottom graph. If you select Zoom, two more options are available.

Step	Notes
3 [Position]	When you are in Zoom view, this option changes the starting point (spread code) of the section of the full view (upper graph) that the Zoom view (lower graph) will expand for more detailed analysis.
4 Enter the position using the numeric keypad.	
5 [Enter]	
6 On [Width] select [32], [64], or [128].	In Zoom view, smaller numbers selected with this option correspond to narrower zoom windows on the full view. If you select 32 for example, you will have the minimum window and maximum zoom. You will also see channel information displayed below each active channel. This information is the spreading factor used by that channel and its spread code or OVFSF number.

Codogram Display

This view provides a history of the spectrum. You can use it to:

- see traffic channels as they come and go,
- track traffic channel call levels over time.

The W-CDMA Tx analyzer Codogram screen is divided into 3 sections in the Zoom view (default—[Figure 18-3 on page 472](#)) and 4 sections in the Full view ([Figure 18-4 on page 473](#)) as follows:

- **Zoom and Full views:** The lower-right graph (**Code Domain Trace view**) shows the power in all 512 OVFSF (Orthogonal Variable rate Spread Factor) Code Channels. For display details, refer to “[Multiple-View Display](#)” on [page 466](#).
- **Zoom view:** The left graph (**Codogram view**) provides a display of data captured over time. The OVFSF codes are shown on the X-axis and correspond to the light blue highlight on the Code Domain Trace view. You can change the time interval to allow longer spectrum history. The color corresponds to the

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OVSF channel strength.

- **Full view:** The top-left graph (**Codogram view**) shows the power in the first half of the OVSF channels (SF512 channels 0 - 255). The lower-left graph shows the power in the other half of the channels (SF512 channels 256-511). Both graphs provide a display of data captured over time. You can change the time interval to allow longer spectrum history. The color corresponds to the OVSF channel strength.
- **Zoom and Full views:** The top-right graph (**Color Legend**) provides a color vs. power legend to help you interpret the power level in the Codogram.

The frequency indicator is at the bottom right corner of the screen, the time reference indicator at the bottom left. For each indicator the text indicates which reference you have chosen. A green LED indicates a locked condition. A red “X” indicates an unlocked condition.

Figure 18-3

The Codogram Zoom Display

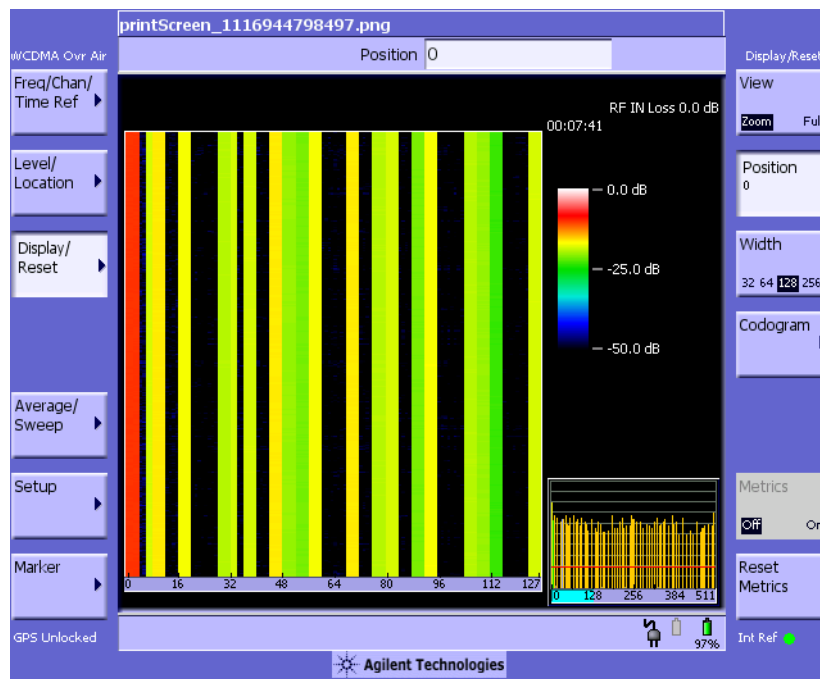
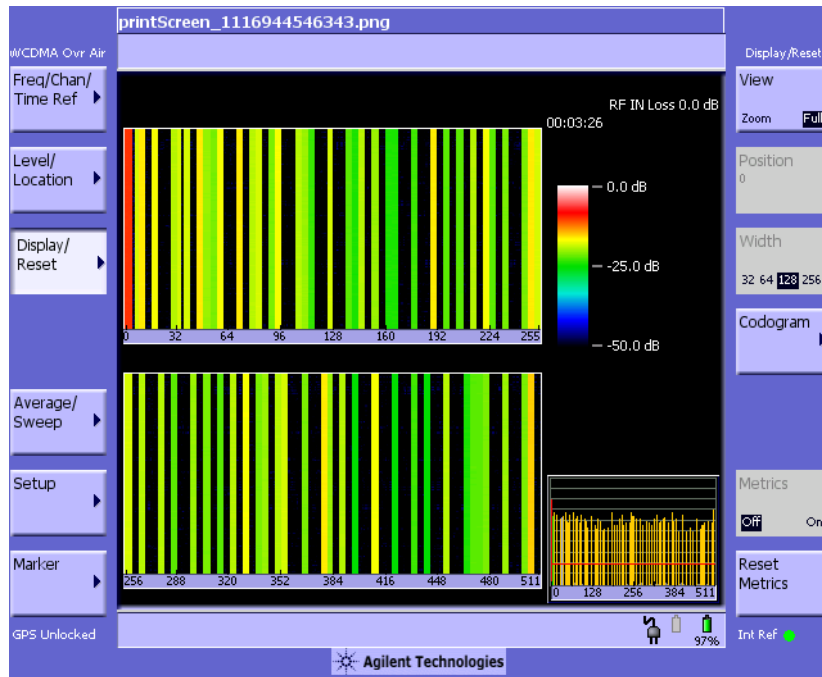


Figure 18-4

The Codogram Full Display



Setting Codogram Display Options

The codogram options let you turn the codogram **On** and **Off**, and control the update rate of the chart.

Step	Notes
1 [Display]	
2 [Codogram]	
3 On [Codogram] select On or Off .	When you set [Codogram] to On, [Reset Codogram], [Capture Interval] and [Palette] become active.
4 [Reset Codogram]	This restarts the data capture for the Codogram. You may see the screen freeze for a few seconds before the display starts plotting data again.

W-CDMA Over the Air
Using the W-CDMA Over the Air Tool

Step	Notes
5	If desired set the capture interval:
a. [Capture Interval]	Allows you to set the capture interval to 1 or more seconds. Or, you may set it to automatically determine the capture interval that provides the maximum data collection rate.
b. Enter the interval number using the numeric keypad.	
c. Select [sec] or [Max Speed].	If you need to return to the automatically determined capture speed, you must press a keypad key to access [Max Speed].
7	If desired set the display color:
a. [Palette]	The color/grayscale top and bottom mappings are determined by the Ref Level and Scale/Div settings. To change the mapping, go to [Level/Location] and change [Ref Level] and [Scale/Div].
b. Select [Full Color] or [Grayscale].	

Optional W-CDMA Over the Air Measurement Settings

You can alter several optional measurement parameters in W-CDMA Over the Air:

- “Setting the Channel or Frequency Step” on page 475
- “Setting the Scrambling Codes” on page 476
- “Setting the Transmitter Reference” on page 476
- “Setting Average, Sweep, and Restart” on page 478
- “Setting the Active Channel Threshold Level and Auto Threshold Offset” on page 480
- “Resetting Amplifier Capacity and Traffic Metrics” on page 480
- “Setting Measurement Time” on page 481
- “Setting Valid Measurement Limits” on page 481
- “Setting the S-CCPCH Parameters” on page 482
- “Setting the PICH Parameters” on page 483
- “Adding a Marker” on page 484

Setting the Channel or Frequency Step

You can set the channel or frequency step so you can quickly increment to the next channel or frequency using the Up Arrow and Down Arrow buttons.

Step	Notes
1 [Chan Step] or [Freq Step]	This choice depends on the [Units] mode you are using.
2 Enter the desired channel or frequency step using the numeric keypad.	
3 [Enter]	Notice (and verify) that the number you entered is displayed below the Chan Step or Freq Step text on the corresponding button.

Setting the Scrambling Codes

The E7495A/B has two ways to identify the scrambling code being used by the transmitter under analysis: an automatic detection mode, **Auto**, and a manually-specified mode, **Manual**.

- In **Auto** mode, the test set automatically detects the scrambling code present in the signal.
- In **Manual** mode, you enter the scrambling code instead of it being auto-detected by the instrument.

If the scrambling code is known, its value can be entered and the test set can decode and display the code domain power of the signal, even if no P-SCH and S-SCH are present (a CPICH must be present, however). In normal operating conditions, these sync channels are available, so the P-SCH and S-SCH are used by the E7495A/B (and W-CDMA mobiles) to determine the correct sequence of scrambling codes required to demodulate the DPCH channels.

Step	Notes
1 [Freq/Chan/Time Ref]	
2 [Scrambling C...]	
3 [Auto] or [Manual]	Each time you press this softkey, the selected option changes. In Manual mode, you can enter a number using the keypad.

Setting the Transmitter Reference

You can set the W-CDMA Tx analyzer display to show the power in each channel as either relative power (dB) or absolute power (dBm). The test set's default display mode is relative. In relative mode, the top horizontal line (top-most graticule) of the display represents the total power (channel power) in the 3.84 MHz bandwidth of that W-CDMA signal being broadcast by the transmitter. It is always 0 dB in this mode since it is a relative measurement. The power in each channel is shown as a vertical bar, with its height expressed in dB relative to the total channel power.

If you set the reference level mode to absolute, then the top graticule in the display still corresponds to total channel power in the 3.84 MHz bandwidth. However, the reference level and all the power values of the vertical bars showing the power in each channel are now indicated with absolute power in dBm.

NOTE

This setting only effects the CDP and Control Channel displays. The Metrics display is not effected.

To set the W-CDMA transmitter reference level:

Step	Notes
1	[Level/Location]
2	On [Reference] select Abs or Rel. Each time you press this softkey, the selected option changes.

Setting Average, Sweep, and Restart

Setting the Sweep

You can select either continuous or single sweep. Continuous sweep provides repeated, ongoing measurements. Single sweep performs a single measurement that is repeated only when you push the Single button.

To set sweep:

Step	Notes
1 [Average/Sweep]	
2 [Continuous] or [Single]	Each time you press this softkey, the selected option changes.

Setting Averaging

You can choose to have averaging **On** or **Off** and set the number of averages you want to take. Averaging only applies to the data, not the trace. When initialized, the Agilent E7495A/B defaults to running average:

- A running average computes the new result as the weighted sum of the last result and the new measurement. The last result is weighted by $(n - 1)/n$. The new result is weighted by $1/n$. Each new measurement produces a new result.

Averaging applies to the following measurement metrics and the control channel view only:

- Freq Error
- Noise Floor
- EVM
- PCDE
- Carrier Feedthrough
- Chan Pwr
- CPICH power
- all the delta powers

- Control Channel Graph

To set averaging:

Step	Notes
1	Set the number of averages. <ol style="list-style-type: none"> a. [Average] b. Enter the number of averages using the numeric keypad. c. [Enter]
2	Set averaging On or Off. <ol style="list-style-type: none"> a. [Average/Sweep] b. [Averaging] c. [Off] or [On]

NOTE

These two steps can be performed in any order. However, if you turn averaging on and a large number of averages has previously been set, there may be a delay before you can change number of averages.

Setting Restart

When you have averaging turned **On** and you are in **Continuous** Sweep mode, you can restart the averaging by pressing the Restart menu key. It also resets the Amplifier Capacity and Traffic metrics. The Restart key has no effect if you are in **Single** sweep mode.

To restart averaging:

Step	Notes
1	[Average/Sweep]
2	[Restart] This key is unavailable or has no effect when Sweep is set to Single. To restart a Single Sweep measurement, press [Single].

Setting the Active Channel Threshold Level and Auto Threshold Offset

The active channel threshold level is an advanced setting that can be set to indicate which code channels are considered active. Any code channels exceeding this power level are considered active traffic channels and any code channels below this power level are considered inactive (or noise). A horizontal red line on the screen represents the threshold level. The test set can set this level automatically, or you can manually enter a value.

In **Auto** mode the threshold level moves as the noise fluctuates. The threshold level is set by the test set at an optimal offset above the average noise floor. If you choose **Auto** mode, you can alter the **Auto Threshold Offset**. The recommended and default setting is 0 dB. A negative value moves the threshold lower (closer to the noise floor) and is a more aggressive setting that increases the likelihood of interpreting an inactive channel as active. A positive value moves the threshold higher (away from the noise floor) and is a more conservative setting that increases the likelihood of interpreting an active channel as inactive.

In **Manual** mode the threshold level is fixed and does not move as the noise fluctuates.

To Set the Active Channel Threshold Level:

Step	Notes
1 [Setup]	
2 On [Thresh Lvl] select Auto or Manual .	Each time you press this softkey, the selected option changes. If you choose Manual, you must enter the threshold you want using the numeric keypad, then press [dB].
3 [Auto Thres Offset]	The default value is 0 dB. Optionally, you can enter a negative (more aggressive) or positive (more conservative) value, then press [dB].

Resetting Amplifier Capacity and Traffic Metrics

The amplifier capacity metrics such as the peak and average amplifier capacity and peak and average utilization can be reset. If you prefer to reset these parameters manually, you may do so using the [Reset Metrics] menu key.

To Manually Reset the Amplifier Capacity Metrics:

Step	Notes
1	[Display/Reset]
2	[Reset Metrics]

Setting Measurement Time

The Measurement Time setting allows you to alter the speed at which measurements are being made. Three choices exist: Slow, Normal, and Fast. The test set defaults to Normal. Slow measurement time provides a more accurate measurement at the expense of time. Fast measurement time provides a quicker measurement at the expense of accuracy. Normal measurement time strikes a balance between measurement speed and measurement accuracy.

Step	Notes
1	[Setup]
2	On [Meas Time] select Slow, Normal, or Fast . Each time you press this softkey, the selected option changes.

Setting Valid Measurement Limits

The Valid Measurement Setting allows you to set the Multipath Power and Pilot Dominance limits. These settings control will help the test set to determine if valid over the air measurements are being made.

Step	Notes
1	[Setup]
2	[Valid Meas Settings]

Step	Notes
3	<p>Set Multipath Power limit.</p> <ol style="list-style-type: none"> [Mp Pwr <] Enter the power level using the numeric keypad. [dB]
4	<p>Set Pilot Dominance limit.</p> <ol style="list-style-type: none"> [Plt Dom >] Enter the power level using the numeric keypad. [dB]

Setting the S-CCPCH Parameters

The S-CCPCH (Secondary Common Control Physical Channel) Setting allows you enable S-CCPCH, set the spread factor, and designate the channel number. The S-CCPCH settings help the test set to determine which channel is the S-CCPCH channel. Once the test set has identified this channel, it can perform the delta power measurements for this channel and display them to the you.

Step	Notes
1	[Setup]
2	[S-CCPCH] This key displays the current Spread Factor, selected channel, and Enable /Disable status.
3	On [S-CCPCH Enable] select On or Off . Each time you press this softkey, the selected option changes.

Step	Notes
4	Set the Spread Factor. <ol style="list-style-type: none"> a. [Spread Factor] b. [4], [8], [16], [32], [64], [128], or [256].
5	Set the channel. <ol style="list-style-type: none"> a. [Channel] b. Enter the channel number using the numeric keypad. c. [Enter]

Setting the PICH Parameters

The PICH (Paging Indicator Channel) Setting allows you enable PICH and designate the channel number. The PICH settings help the test set to determine which channel is the PICH channel. Once the test set has identified this channel, it can perform the delta power measurements for this channel and display them to you.

Step	Notes
1	[Setup]
2	[PICH]
3	On [PICH Enable] select On or Off .

[Spread Factor] is grayed out and unavailable because the spread factor is fixed at 256.

Step	Notes
4	Set the channel.
	a. [Channel]
	b. Enter the channel number using the numeric keypad.
	c. [Enter]

Adding a Marker

Markers can be used on traces to help you visually track up to four signals. Each marker has the following settings:

- **Type:** Provides three options, including:
 - **Off**
 - **Normal**, which places a diamond-shaped, colored marker, along with a number, 1-4, on the trace.
 - **Δ (Delta)**, is associated with a normal marker. Therefore, a normal marker must exist prior to creating the delta marker. The delta marker displays the difference between the normal marker position and the delta marker position. Only one delta marker can be associated with a given normal marker. The normal marker must be active when Delta is selected.
- **Marker to Peak:** Places the active marker on the current greatest value of the trace.
- **Marker to Next Peak:** Places the active marker on the current second greatest value of the trace.

Step	Notes
1	[Marker]
2	[Marker]
3	[1], [2], [3], or [4]
4	[Type]
5	[Off], [Normal], or [Delta]

Step	Notes
6 Locate the marker relative to the trace: <ul style="list-style-type: none"><li>• [Marker to Peak] or<li>• [Marker to Next Peak]	

Metrics Provided by the W-CDMA Analyzer Measurement

This section contains descriptions of the individual W-CDMA transmitter metrics in the Metrics view of the screen. The [“Interpretation of W-CDMA Measurement Results” on page 352](#) section contains expected result values and possible causes of error if the expected results are not met.

Frequency

Frequency is the selected transmitter operating frequency you have entered (or calculated from the channel number you have entered).

Freq Error (Frequency Error)

Frequency error is the frequency difference between your transmitter's actual center frequency and the frequency (or channel) you entered.

Scramble Code

The scramble code of the sector or BTS being measured.

Noise Floor

Noise Floor is the average power level of all the inactive channels.

Carr Ft (Carrier Feedthrough)

Carrier Feedthrough is a result of the RF carrier signal feeding through the I/Q modulator and riding on the output circuitry without being modulated.

EVM (Error Vector Magnitude)

EVM is the measure of signal quality specified as a percent of noise to pure signal. It is the difference between the measured waveform and the theoretical modulated waveform (the error vector). EVM metrics are used to measure the modulation quality of a transmitter. The 3GPP standard requires the EVM not to exceed 17.5%.

PCDE (Peak Code Domain Error)

PCDE takes the noise and projects the maximum impact it will have on all OVSF codes. PCDE is the maximum value for the code domain error for all codes (both active and inactive).

In W-CDMA, specifically to address the possibility of uneven error power distribution, the EVM measurement has been supplemented with PCDE. The 3GPP standard requires the PCDE not to exceed -33 dB at a spreading factor of 256.

Utilization

Utilization is a ratio of the active OVFS codes to the total SF512 codes, expressed as a percentage. Even though active control channels such as the pilot are included in the utilization measurement, utilization is an indication of the traffic that is being carried by the base station.

For example, W-CDMA signal with CPICH, PCCPCH, SCCPCH using SF256, and PICH, would use 8 of 512 SF512 codes, giving a utilization of 1.6%.

Pk Util (Peak Utilization)

Peak Utilization is the peak level of all the valid Utilization measurements while on the same Scrambling code. In Scrambling code Auto mode this measurement is reset if the Scrambling code changes or the Reset Metrics button is used. In Scrambling code Manual mode this measurement is reset only if the Reset Metrics button is used.

Avg Util (Average Utilization)

Average Utilization is the average level of all the valid Utilization measurements while on the same Scrambling code. In Scrambling code Auto mode this measurement is reset if the Scrambling code changes or the Reset Metrics button is used. In Scrambling code Manual mode this measurement is reset only if the Reset Metrics button is used.

Chan Pwr (Channel Power)

Channel Power is the integrated power within a defined bandwidth. For W-CDMA the channel bandwidth is 3.84 MHz. Channel Power measures the power the base station is transmitting across the entire 3.84 MHz W-CDMA channel.

CPICH (Common Pilot Channel)

Common Pilot Channel (CPICH) is the channel that carries the scrambling code.

Amp Cap (Amplifier Capacity)

Assuming the Amplifier Capacity parameters are set properly, the Amplifier Capacity measurement is an estimate of the amount of power amplifier capacity that is being used, expressed in percent of maximum. When an amplifier is transmitting at maximum output power, it is said to be at 100% of its capacity. For example, an

Metrics Provided by the W-CDMA Analyzer Measurement

amplifier with a maximum output power of 12 watts would be at 50% of capacity when transmitting 6 watts and at 100% of capacity when transmitting at 12 watts.

The percentage of amplifier capacity generally increases as the number or level of the traffic channels increase.

Pk Cap (Peak Amplifier Capacity)

Peak Amplifier Capacity is the peak level of all the valid Amplifier Capacity measurements while on the same Scrambling code. In Scrambling code Auto mode this measurement is reset if the Scrambling code changes or the Reset Metrics button is used. In Scrambling code Manual mode this measurement is reset only if the Reset Metrics button is used.

Avg Cap (Average Amplifier Capacity)

Average Amplifier Capacity is the average level of all the valid Amplifier Capacity measurements while on the same Scrambling code. In Scrambling code Auto mode this measurement is reset if the Scrambling code changes or the Reset Metrics button is used. In Scrambling code Manual mode this measurement is reset only if the Reset Metrics button is used.

Interpretation of W-CDMA Over the Air Measurement Results

This section contains expected result values and possible causes of error if the expected results are not met.

Frequency

If you are in the channel mode, verify that the correct channelization and channel number are set.

Freq Error (Frequency Error)

The frequency error of the analyzer should be <1 kHz. If the frequency error is greater than this, there could be a possible malfunction in the base station equipment. Other possible explanations for Frequency Error include:

- the effects of multipath transmission
- pilot dominance
- failure of the base station to lock onto a GPS signal

Before performing a procedure to check the base station equipment, check to ensure that the test set is performing a correct measurement. You can do this by reviewing the frequency reference settings for the test set (refer to [“Setting the Transmitter Reference” on page 476](#)). Ensure that these settings are correct, and that the test set shows reference lock. Lastly, make sure the test set has been powered on, and has been locked for at least 15 minutes.

If the error is still occurring after performing the above procedures, you will need to check the Base Station equipment for a source of the error. You can also verify that the base station is malfunctioning by turning off its modulation hardware and performing a frequency measurement on the Base Station carrier signal in the spectrum analyzer mode of the test set (refer to [“Performing a Basic Spectrum Analyzer Measurement” on page 121](#)).

Scramble Code

If the Scramble code is not as expected, it could be due to an incorrect Base Station setting or to incorrect positioning of the test set. Use of the “strongest pilot” display to position the test set. If the correct Scrambling code cannot be located, check the base station settings.

Noise Floor

An unexpectedly high noise floor could be due to interfering signals.

Carr Ft (Carrier Feedthrough)

A good Carrier Feedthrough level is less than -25 dBc. The 3GPP standard does not specify Carrier Feedthrough; however, this measurement provides an additional tool to troubleshoot the base station's transmitter.

In the frequency domain, Carrier Feedthrough can show up as an energy spike that can be seen on the spectrum analyzer by closely spanning into the top of the W-CDMA signal. The effects of Carrier Feedthrough can also show up as higher noise levels on the Code Domain Power screen. Carrier Feedthrough can be caused by the lack of isolation across the mixer and cavity of the transmitter's I/Q modulator.

EVM (Error Vector Magnitude)

An unexpectedly high EVM could be due to interfering signals, carrier feedthrough, pilot dominance, or multipath power. If these are all correct, check for transmitter I/Q modulator or signal path problems.

PCDE (Peak Code Domain Error)

An unexpectedly high PCDE could be due to interfering signals, carrier feedthrough, pilot dominance, or multipath power. If these are all correct, check for transmitter I/Q modulator or signal path problems.

Utilization

The Utilization metric provides an instantaneous reading of the percentage of the traffic channels currently being used. More meaningful information is provided by the Peak and Average Utilization metrics gathered over a 10 to 15 minute interval.

Pk Util (Peak Utilization)

If the Peak Utilization of this base station is greater than 65%, this is a warning that peak traffic rates at this base station are getting very high. It is possible that calls could be getting blocked or dropped.

Avg Util (Average Utilization)

If the Average Utilization of this base station is greater than 45%, the base station is carrying a great deal of traffic. Service providers may want to consider expanding their network infrastructure to support higher system (call) demands.

Chan Pwr (Channel Power)

If the Channel Power level is not as expected, check pilot dominance and the number of Scramble codes visible. All visible sectors will contribute to channel power. Also, check Amplifier Capacity and Utilization as they could have exceeded the maximum capacity. A high power data call could be indicated by a very wide and tall bar.

CPICH (Common Pilot Channel)

CPICH will vary with distance from the base station and clear line of sight to the antenna. If the CPICH is not as expected, check pilot dominance and base station settings (ratio to other control channels should be good).

Amp Cap (Amplifier Capacity)

The Amplifier Capacity metric provides an instantaneous reading of how much of the amplifier's capacity is currently being used. More meaningful information is provided by the Peak and Average Amplifier Capacity metrics gathered over a 10 to 15 minute interval.

Pk Amp Cap (Peak Amplifier Capacity)

If the Peak Amplifier Capacity is greater than 100%, the traffic at this base station has caused the base station amplifier to exceed its maximum power rating. This is not desirable as this problem can result in system degradation or damage to the amplifier.

You can get an indication of how often the amplifier capacity is being exceeded by watching the Amplifier Capacity measurement. This is an instantaneous measurement of the amplifier capacity.

Avg Amp Cap (Average Amplifier Capacity)

If the Average Amplifier Capacity is greater than 85%, the base station power amplifier is close to its maximum power limit. Further increase in traffic on this base station could cause system performance problems or damage to the power amplifier. You should notify your RF Engineering Department as soon as possible.

W-CDMA Over the Air

Interpretation of W-CDMA Over the Air Measurement Results

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- “Setting System References” on page 496
 - “Displaying GPS Location Data” on page 496
 - “Selecting a Frequency/Timing Reference” on page 496
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System Reference Introduction

The Agilent E7495A/B Base Station Test Sets provide a system utility that allows you to perform non-measurement activities and to configure the test set for:

- General operations
- System status updates
- Data manipulation
- Basic system functions testing

Setting System References

The Agilent E7495A/B provide a utility to preconfigure the global settings for the box.

Displaying GPS Location Data

Perform this procedure to have the current GPS location data visible on the screen at all times.

Step	Notes
1 [System]	
2 [Fr/Time Ref Location]	
3 On [Show GPS Location] select On .	Each time you press this softkey, the selected option changes.

NOTE

A GPS locked or unlocked indicator is located in the bottom-left of the screen. It indicates whether or not the GPS signal is being captured.

Selecting a Frequency/Timing Reference

Perform this procedure to select a common frequency or timing reference to be used for all measurement tools (when applicable).

Step	Notes
1 [System]	
2 [Fr/Time Ref Location]	

Step	Notes
3 [Fr/Time Ref]	Displays additional menu buttons. With Internal GPS and External Even Sec, both frequency and time references are active. This is used when measuring CDMA signals to get valid PN offsets. With the other five options, you get only frequency.
4 Select the frequency/timing reference you want.	

NOTE

A frequency/time reference indicator in the lower-right of the screen shows both the selected reference and its status.

Reference indicators include: “GPS,” “Int Ref,” “Even Sec,” “Ext 10 MHz,” “Ext 13 MHz,” or “Ext 19.66 MHz.”

Status indicators include:

- Green dot to indicate that the reference is locked
- Yellow triangle to indicate that the reference is acquiring lock
- Red X to indicate that the reference is not locked

Setting up the DC Bias Option

The DC Bias Tee, Option 300, provides power from the Agilent E7495B to the amplifier at the top of a base station tower, or the end of the cable run. The DC voltage (12 volts) is output on the center conductor of Port 1, RF Out. The option enables you to test with the amplifier powered on. DC bias defaults to off when you select a new measurement type which does not depend on either Port 1 or Port 2, and it must be turned on each time you want to use it. It stays on as long as you’re using measurements that use RF In or Out. DC Bias cannot be saved in the On position as a state and is turned off when the power is cycled, including when going into the sleep state. If you do not have the option, it is grayed out on the screen.

NOTE

The maximum current draw is 800 milliamps.

Basic System Operations

Setting System References

Step	Notes
1 System	
2 [Fr/Time Ref Location]	
3 [DC Out] [On]	Each time you press this softkey, the selected option changes.

WARNING

If you have tripped the RPP or are over the current limit for the DC bias, a warning screen appears. However, if you have shorted the output, the short may not be detected, and the test set will shut off current to the DC Bias port.

Printing a Screen to a File

The E7495A/B lets you save screen images to PNG files. You can save the image files to a PCMCIA card or to a CompactFlash card.

Printing Screens

Step	Notes	
1	Display data on a measurement screen.	
2	Insert the PCMCIA or CompactFlash card.	
3	Select the card you want to use by selecting the output media (see “Selecting Output Media—PCMCIA Card or CompactFlash Card” on page 503).	This step need only be performed the first time you insert a new card type.
4	Select how you want to name the data file you’re saving (see “File Naming Options” on page 500).	This step need only be performed prior to the first time you save a file, or if you want to change the method you use.
5	[Print Screen]	
6	Enter a name for the file (or it is done automatically, depending on the file naming method you selected).	The name you provide is displayed on the top of the screen image that is stored in your .PNG file.

Selecting Output Media—PCMCIA Card or Compact Flash Card

Step	Notes
1	[System]

Basic System Operations

Printing a Screen to a File

Step	Notes
2	[Print Screen Setup]
3	On [File Location] select PCMCIA or CF . Each time you press this softkey, the selected option changes.

File Naming Options

You have three options for naming image files. You can

- Name each file automatically using this format:
saveData_YYYYMMDD_HHMMSS.png
- Name each file individually, and enter the name you want. This is called User file naming.
- Have the test set ask you how you want to name each file for each file you save.

Setting Up Automatic File Naming

Step	Notes
1	[System]
2	[Print Screen Setup]
3	On [Filename] select Auto . Each time you press this softkey, the selected option changes.

Setting Up User File Naming

Step	Notes
1	[System]
2	[Print Screen Setup]
3	On [Filename] select User . Each time you press this softkey, the selected option changes.

Step	Notes
4	Setup file naming. <ol style="list-style-type: none">[User Filename]If the filename does not exist, use the rotary knob or up and down arrow buttons to select a letter and the buttons on the left to change cursor positionFor each character entered, press [Enter]. If the filename does exist, select [Choose File...] on the right to display a list of the current files on the selected media.Use the rotary knob to select the file and press Select.[Ok]
5	[If File Exists]
6	[Overwrite], [Prompt], [Auto Incr], or [Timestamp] <ul style="list-style-type: none">• Overwrite—overwrites existing file data with new file data.• Prompt—prompts you to input a new file name.• Auto Incr—automatically increments the filename and retains the existing filename.• Timestamp—attaches a timestamp to the filename to distinguish it from the existing file.

Setting Up Asking For Filename

You can choose to have the test set ask you at the time you print a screen how you want to name the file. For every file you save, you can choose to specify automatic naming or to enter the filename you want.

Basic System Operations

Printing a Screen to a File

Step	Notes
1	[System]
2	[Print Screen Setup]
3	On [Filename] select Ask . Each time you press this softkey, the selected option changes.

Saving Data

Saving data

Step	Notes	
1	Display data on a measurement view.	
2	Insert the PCMCIA or CompactFlash card.	
3	Select the card you want to use by selecting the output media (see “Selecting Output Media—PCMCIA Card or CompactFlash Card” on page 503).	This step must only be performed the first time you insert a new card type.
4	Select how you want to name the data file you’re saving (see “File Naming Options” on page 500).	This step must only be performed prior to the first time you save a file, or if you want to change the method you use.
5	[Save Data]	
6	Enter a name for the file (or it is done automatically, depending on the file naming method you selected).	

Selecting Output Media—PCMCIA Card or CompactFlash Card

Step	Notes
1	[System]
2	[Save Data Setup]

Basic System Operations

Saving Data

Step	Notes
3 On [File Location]	Each time you press this softkey, the selected option changes.

File Naming Options

You have three options for naming data files. You can:

- Name each file automatically using this format:
saveData_YYYYMMDD_HHMMSS.xls
- Name each file individually, and enter the name you want. This is called User file naming.
- Have the test set ask you how you want to name each file at the time you save the data.

Setting Up Automatic File Naming

Step	Notes
1 [System]	
2 [Save Data Setup]	
3 On [Filename] select Auto .	Each time you press this softkey, the selected option changes.

Setting Up User File Naming

Step	Notes
1 [System]	
2 [Save Data Setup]	
3 On [Filename] select User .	Each time you press this softkey, the selected option changes.

Step	Notes
<p>4 Setup file naming.</p> <ol style="list-style-type: none"> a. [User Filename] b. If the filename does not exist, use the rotary knob or up and down arrow buttons to select a letter and the buttons on the left to change cursor position c. For each character entered, press [Enter]. If the filename does exist, select [Choose File...] on the right to display a list of the current files on the selected media. d. Use the rotary knob to select the file and press Select. e. [Ok] 	
5 [If File Exists]	
6 [Overwrite], [Prompt], [Auto Incr], or [Timestamp]	<ul style="list-style-type: none"> • Overwrite—overwrites existing file data with new file data. • Prompt—prompts you to input a new file name. • Auto Incr—automatically increments the filename and retains the existing file name. • Timestamp—attaches a timestamp to the filename to distinguish it from the existing file.

Setting Up Asking For Filename

You can choose to have the test set ask you at the time you save a data file how you want to name the file. This option means that for every file you save, you will be able to specify automatic naming or enter the filename you want.

Basic System Operations

Saving Data

Step	Notes
1	[System]
2	[Save Data Setup]
3	On [Filename] select Ask . Each time you press this softkey, the selected option changes.

Managing Media Types

The E7495A/B is compatible with two media types for storing and retrieving data: PCMCIA card and CompactFlash card. The media type buttons are not active until a media card is inserted and recognized by the E7495A/B. Upon proper recognition, the test set allows you to perform basic media tasks with each media type.

Formatting a PCMCIA or CompactFlash Card

You need to perform this procedure to prepare a new or existing PCMCIA or CompactFlash storage card for data storage.

Step	Notes
1	Make sure the card you will format is inserted in its slot.
2	[System]
3	[Media Manager]
4	[Format PCMCIA] or [Format CF] Prepares a PCMCIA or CompactFlash card for storage. Erases existing data on the card.

Test Software Operation

Your E7495A/B can be optioned for various software options. Refer to the appropriate software manual for the usage of the Test Software key and Software Utilities key.

Importing or Exporting Configuration Files from a compact flash or PCMCIA flash memory card.

You can perform this procedure to import or export Test Software configuration files to or from a PCMCIA or a CompactFlash storage card.

Basic System Operations

Managing Media Types

Step	Notes
1	Make sure the card with the software configuration files or a card with adequate free space to receive the files is inserted in its slot.
2	[System]
3	[Media Manager]
4	To import configuration files from a memory card [Import Config Files] a. [from PCMCIA] or [from CF]; depending on which memory card you are using. b. Follow the on screen instructions.
5	To export configuration files to a memory card [Export Config Files] a. [to PCMCIA] or [to CF]; depending on which memory card you are using. b. Follow the on screen instructions.

Configuring for Network Connectivity

The E7495A/B can operate as a device on any compatible network. In order to be accessible on the network, certain information must be entered so the test set can communicate with other devices. Configuring the test set for network activity is performed by using the IP administrator located in the system utilities.

IP Administration Using DHCP

Perform this procedure to allow your test set to be integrated into an existing network that uses DHCP to dynamically assign an IP address. This procedure requires that you have the System Name (available from your network administrator).

Step	Notes
1 [System]	
2 [Controls]	
3 [IP Admin]	
4 [Sys Name]	
5 Enter the name of the test set.	This is automatically assigned by the network administrator.
6 [Ok]	
7 On [DHCP] select On .	An IP address and other network information will automatically be assigned if the Sys Name is recognized by the network.
8 [Save]	
9 [Ok]	Saves the current configuration and restarts the test set. DHCP will dynamically assign an IP address.

IP Administration Without DHCP

Perform this procedure to allow your test set to be integrated into an existing network that uses a technique other than DHCP for its IP address assignments. One

Basic System Operations

Configuring for Network Connectivity

example of an alternative technique used for IP address assignments is DNS. This procedure requires the following specific data from the network administrator:

- System name
- IP address
- Net mask
- Gateway

Step	Notes
1	[System]
2	[Controls]
3	[IP Admin]
4	[Sys Name]
5	Enter the name of the test set. This name is usually assigned by the network administrator.
6	[Ok]
7	On [DHCP] select Off . Each time you press this softkey, the selected option changes.
Now you must specify relevant network information for the test set to be recognized. Contact your network administrator if you do not have this information.	
8	[IP Address]
9	Enter the IP address. Use the rotary knob and menu keys on the left.
10	[Ok]
11	[Net Mask]
12	Enter the Net Mask. Use the rotary knob and menu keys on the left.
13	[Ok]
14	[Gateway]
15	Enter the Gateway. Use the rotary knob and menu keys on the left.

Step	Notes
16 [Ok]	
17 [Save]	
18 [Ok]	Saves the current network configuration and restarts the test set.

Saving, Recalling, and Deleting Instrument States

You can save the current configuration of buttons and settings for recall at a later time. You can also save a customized power-up state, which the test set will use the each subsequent time it is powered on. This enables you to configure common usage and power-on states to speed up base station testing.

Saving the State

Step	Notes
1	Configure all measurement settings you want to save.
2	[Save State]
3	Enter the state name you want to use, for example, "Remote base station."
4	[Ok]

Saving the Power-Up State

Step	Notes
1	Configure all measurement settings you want to save.
2	[Save State]

Step	Notes
3	Enter the state name, “Power up” (the test set is case-sensitive, so be sure to capitalize the “P”).
4	[Ok]

Recalling the State

Step	Notes
1	[Recall State]
2	Select from the list the state you want to recall. Use the rotary knob or the up and down arrow buttons to select the state you want to delete. All states, in addition to two supplied in the test set, are displayed: <ul style="list-style-type: none"> • Powerup - The default power-up state shipped with the test set, or the power-up state last saved with the test set. • Factory Defaults - The default power-up state shipped with the test set. You can always revert to it by selecting it in this procedure.
3	[Select]

Returning the Power-Up State to Factory default

Step	Notes
1	[Recall State]
2	Select Factory Defaults from the list. Use the rotary knob or the up and down arrow buttons to select the state you want to delete.

Basic System Operations

Saving, Recalling, and Deleting Instrument States

Step	Notes
3	[Select]
4	[Save State]
5	Enter the filename, “Powerup” (the test set is case-sensitive, so be sure to capitalize the “P”).
6	[Ok]

Deleting States

If you have saved a state you will no longer use, you can delete it.

Step	Notes
1	[System]
2	[Save/Recall]
3	[Delete States]
4	Select the state you want to delete or [All] to delete all saved states. Use the rotary knob or up and down arrow buttons to select the state you want to delete.
5	[Select]

NOTE

Selecting [All] does not delete the Powerup or Factory Defaults states.

Viewing System Statistics

The E7495A/B provides a utility that allows you to:

- Check test set status
- Verify operational readiness
- Perform system configuration
- Check the system software version

Viewing System Release Versions

Perform this procedure to view the current version of software and firmware for enabled features.

Step	Notes
1 [System]	
2 [More 1 of 2]	
3 [System Stats]	
4 [Rev Info]	View version information for system firmware.
5 [Page Up]	Use these buttons to scroll to the next screen.
or	
[Page Down]	

Viewing System Memory

Perform this procedure to view current allocation and usage statistics of the memory available.

Step	Notes
1 [System]	
2 [More 1 of 2]	
3 [System Stats]	

Basic System Operations

Viewing System Statistics

Step	Notes
4 [Memory]	View status of total, used, and available memory.

Viewing Battery Statistics

Perform this procedure to view current status and battery usage.

Step	Notes
1 [System]	
2 [More 1 of 2]	
3 [System Stats]	
4 [Battery]	View the status of battery conditions. For details, see “System Statistics—Battery Screen” on page 558
5 As needed, [Page Up] or [Page Down]	Use these menu keys if you need to scroll up or down to see all the information.

Using the Option Manager

The E7495A/B provides a utility that allows you to:

- View installed options
- View installable options (by user and by factory)
- View installation information
- Install an option

Viewing Installed Options

Step	Notes
1 [System]	
2 [More 1 of 2]	
3 [Option Manager]	
4 [Installed Options]	Provides a list of all installed options.
5 [Page Up]	Use as necessary to scroll to the next screen.
or	
[Page Down]	

Viewing Installable Options

Perform this procedure to view a list of all options that you can install for the test set. Two lists are displayed: options you can install yourself and options that must be installed at the factory.

Step	Notes
1 [System]	
2 [More 1 of 2]	
3 [Option Manager]	

Basic System Operations

Using the Option Manager

Step	Notes
4 [Installable Options]	Provides a list of options that can be installed.
5 [Page Up] or [Page Down]	Use as necessary to scroll to the next screen

Installing an Option

Step	Notes
1 [System]	
2 [More 1 of 2]	
3 [Option Manager]	
4 [Installing an Option]	Follow the on-screen instructions.

Viewing Installation Information

Perform this procedure to view current manufacturing information about your test set that must be provided to Agilent to install a user-installable option.

Step	Notes
1 [System]	
2 [More 1 of 2]	
3 [Option Manager]	
4 [Install Info]	When you call your Agilent sales representative to order an option, you will need to provide the information you see on this screen: <ul style="list-style-type: none">• Model number• Serial number• Host ID

Testing System Functions

The E7495A/B provides two simple tests you can perform to test the basic system functionality: a display test and a keyboard test.

Testing Your Display

Perform this procedure to verify the correct operation of your display device.

Step	Notes
1	[System]
2	[More 1 of 2]
3	[Service]
4	[Verification]
5	[Display Test] Follow directions on screen.

Testing Your Keyboard

Perform this procedure to verify the correct operation of your keyboard device.

Step	Notes
1	[System]
2	[More 1 of 2]
3	[Service]
4	[Verification]
5	[Keyboard Test] Press the available buttons and view the results on the screen.

Basic System Operations
Testing System Functions

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Safety and Regulatory Information and Specifications

- “Safety considerations” on page 522
 - “Safety Symbols” on page 522
 - “Safety Considerations For This Test Set” on page 523
 - “Lifting and Handling” on page 524
 - “Electrostatic Discharge (ESD) Precautions” on page 525
 - “Product Markings” on page 526
 - “Batteries: Safe Handling and Disposal” on page 527
- “Certification and Compliance Statements” on page 533
 - “Certification” on page 533
 - “Manufacturer’s Declaration” on page 533
 - “Declaration of Conformity for Agilent E7495A” on page 534
 - “Declaration of Conformity for Agilent E7495B” on page 535
 - “Compliance with German Noise Requirements” on page 536
 - “Compliance with Canadian EMC Requirements” on page 536
- “E7495A/B Base Station Test Set Specifications” on page 537
 - “Battery Pack Specifications” on page 550

Safety considerations

General

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product has been designed and tested in accordance with IEC Publication 61010-1+A1+A2:1992 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use and has been supplied in a safe condition. This instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

Safety Earth Ground

A uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

Chassis Ground Terminal

To prevent a potential shock hazard, always connect the rear-panel chassis ground terminal to earth ground when operating this test set from a dc power source.

Safety Symbols



Indicates test set damage can occur if indicated operating limits are exceeded. Refer to the instructions in this guide.



Indicates hazardous voltages.



Indicates earth (ground) terminal

WARNING

A **WARNING** note denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a **WARNING** sign until the indicated

conditions are fully understood and met.

CAUTION

A CAUTION note denotes a hazard. It calls attention to an operation procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond an CAUTION note until the indicated conditions are fully understood and met.

Safety Considerations For This Test Set

WARNING

Whenever it is likely that the protection has been impaired, the test set must be made inoperative and be secured against any unintended operation.

If this test set is to be energized via an autotransformer (for voltage reduction), make sure the common terminal is connected to the earth terminal of the power source.

If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.

No operator serviceable parts in this product. Refer servicing to qualified personnel. To prevent electrical shock, do not remove covers.

Servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.

The opening of covers or removal of parts is likely to expose dangerous voltages. Disconnect the product from all voltage sources while it is being opened.

Adjustments described in the manual are performed with power supplied to the test set while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

For Continued protection against fire hazard, replace the line fuse(s) with T 250 V 5.0 A fuse(s) or the same current rating and type. Do not use repaired fuses or short circuited fuseholders.

WARNING

This product is a Safety Class I test set (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.

Safety and Regulatory Information and Specifications

Safety considerations

WARNING

Always use the three-prong ac power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause personal injury and/or product damage.

This product is designed for use in Installation Category II and Pollution Degree 3 per IEC 61010 and IEC 60664 respectively.

This product has autoranging line voltage input, be sure the supply voltage is within the specified range.

To prevent electrical shock, disconnect test set from mains (line) before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.

Ventilation Requirements: When installing the product in a cabinet, the convection into and out of the product must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the product by 4 ° C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 watts, then forced convection must be used.

WARNING

If you are charging the batteries internally—even while the test set is powered off—the test set may become warm. Take care to provide proper ventilation.

WARNING

Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended. Discard used batteries according to manufacturer's instructions.

WARNING

To avoid overheating, always disconnect the test set from the AC adapter before storing the test set in the soft carrying case.

If you prefer to leave the test set connected to the AC adapter while inside the soft carrying case, you can disconnect the AC adapter from its power source to prevent overheating.

Lifting and Handling

When lifting and handling the Agilent E7495A/B Base Station Test Set use ergonomically correct procedures. Lift and carry the test set by the carrying strap.

Electrostatic Discharge (ESD) Precautions

This test set was constructed in an ESD (electrostatic discharge) protected environment. This is because most of the semiconductor devices used in this test set are susceptible to damage by static discharge.

Depending on the magnitude of the charge, device substrates can be punctured or destroyed by contact or mere proximity of a static charge. The result can cause degradation of device performance, early failure, or immediate destruction.

These charges are generated in numerous ways such as simple contact, separation of materials, and normal motions of persons working with static sensitive devices.

When handling or servicing equipment containing static sensitive devices, adequate precautions must be taken to prevent device damage or destruction.

Only those who are thoroughly familiar with industry accepted techniques for handling static sensitive devices should attempt to service circuitry with these devices.

Safety and Regulatory Information and Specifications

Safety considerations

Product Markings



The CE mark shows that the product complies with all relevant European legal Directives (if accompanied by a year, it signifies when the design was proven).



The CSA mark is a registered trademark of the Canadian Standards Association.



The off symbol is used to mark a position of the instrument power line switch.



The on symbol is used to mark a position of the instrument power line switch.



The standby symbol is used to mark a position of the instrument power line switch.



The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency.

Batteries: Safe Handling and Disposal

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SECTION 1 - PRODUCT IDENTIFICATION AND USE				
Product:	MoliceL - Cobalt based Lithium-Ion cell (up to and including 2.4 Ah)	P.I.N.: Not Regulated		
Use:	High performance lithium-ion rechargeable battery system.	W.H.M.I.S.: exempt. manufactured article		
Manufacturer:	E-One Moli Energy (Canada) Limited 20,000 Stewart Cres. Maple Ridge, BC, Canada V2X 9E7 (604) 466-6654 FAX: (604) 466-6600	24 HOUR EMERGENCY NUMBER (604) 466-6654 (MOLI)		
SECTION 2 - HAZARDOUS INGREDIENTS				
Hazardous Ingredients	%	CAS Number	LD ₅₀ (mg/kg) (oral-rat)	LC ₅₀ (mg/L)
Aluminium foil	0.1- 1 w/w	7429-90-5	N/AV	N/AV
Biphenyl (BP)	0-0.3 w/w	92-52-4	2400	N/AV
Copper foil	0.1- 1 w/w	7440-50-8	3.5 (ipr-mouse)	N/AV
Dioxathiolane 2,2-Dioxide (DTD)	0 – 3 w/w	1072-53-3	1600	N/AV
Linear and Cyclic Carbonate Solvents (See Other Information)	5- 17w/w	N/APP	~11000 (weighted avg)	N/AV
Graphite, powder	10- 30 w/w	7440-44-0	440 (ivn-mouse)	N/AV
Lithium Carbonate	0–0.3 w/w	554-13-2	525	N/APP
Lithium Cobaltite (LiCoO ₂)	10- 30 w/w	12190-79-3	N/AV	N/AV
Lithium Hexafluorophosphate (LiPF ₆)	1- 5 w/w	21324-40-3	1702	Rat: >20
Poly (vinylidene fluoride) (PVDF)	0.1- 1 w/w	24937-79-9	N/AV	N/AV
Propane Sultone (PS)	0 – 3 w/w	1120-71-4	100	N/AV
Steel, nickel and inert polymer	Balance	N/APP	N/APP	N/APP

Safety and Regulatory Information and Specifications

Safety considerations

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SECTION 3 - PHYSICAL DATA				
Physical state: Nickel plated metal canister under label		Odour None		Odour threshold: N/APP
Vapour pressure (mmHg) N/APP	Vapour Density (air =1) N/APP	Evaporation rate : N/APP	Boiling Point N/APP	Freezing point N/APP
pH (10% in water) N/APP	Specific gravity: 1.5-2.0	Coeff. of water/oil distribution N/APP	Water solubility: insoluble	Percent Volatiles: NONE
SECTION 4 - FIRE AND EXPLOSION DATA				
Flammability NO	Conditions: Organic components will burn if cell incinerated. Combustion of cell contents will cause evolution of Hydrogen Fluoride.			
Means of Extinction and Special Procedures: Water spray, Carbon Dioxide, Dry chemical powder or appropriate foam. Use agent appropriate for surrounding materials. Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes. Extremely corrosive Hydrogen Fluoride gas is produced upon combustion of cell contents.				
Flashpoint: NONE	Upper Flammable Limit: NONE	Lower Flammable Limit: NONE		
Auto-ignition Temp: NONE	Hazardous Combustion Products: Hydrogen Fluoride, Phosphorus Oxides, Carbon oxides, Lithium Hydroxide, Cobalt Oxides, Aluminium Oxide, Sulphuric acid, Sulphur oxides, possible fluoro-compounds, Carbon soot			
Impact sensitive: NO	Static Discharge Sensitive: NO, but cell may contain up to 4.2 volts.			
SECTION 5 - REACTIVITY DATA				
Stability: STABLE	Hazardous polymerization will not occur. Spontaneous decomposition at normal temperatures will not occur.			
Incompatibilities: Do not crush, puncture, incinerate, immerse in water or heat over 100 C. Steel casing slowly dissolves in strong mineral acids.				
Reactivities: None known				
Hazardous Decomposition Products: Hydrogen Fluoride, Phosphorus Oxides, Carbon oxides, Lithium Hydroxide, Cobalt Oxides, Aluminium Oxide, Sulphuric acid, Sulphur oxides, possible fluoro-compounds, Carbon soot				

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SECTION 6 - TOXICOLOGICAL PROPERTIES			
Routes of Entry: Skin Contact: NO Skin Absorption NO Eye contact: NO Inhalation NO Ingestion NO			
Acute Exposure			
Skin: No effect noticed in routine handling of product.			
Eyes: The bulk solid has no effect on the eye beyond blunt impact.			
Inhalation: Not applicable.			
Ingestion: Ingestion is not likely, given the physical size and state of the cell.			
Chronic Exposure			
Skin: None anticipated.			
Eyes: Not applicable.			
Inhalation: Not applicable.			
Ingestion: Ingestion is not a likely exposure route.			
Exposure Limits None listed	Irritancy: None	Sensitization: Not anticipated	Carcinogenicity Not anticipated
Teratogenicity: Not anticipated		Mutagenicity: Not anticipated.	
Reproductive toxicity: Not anticipated		Synergistic Products: None expected	
SECTION 7- PREVENTIVE MEASURES			
Personal protective equipment:			
Gloves: Not required for handling individual cells. Fabric gloves for warehouse container handling.	Respirator: No respirator required for normal handling. SCBA required for fires.	Eyewear: Not required beyond employer policy.	
Clothing: Standard industrial clothing in normal use. Impervious suit in fires.		Footwear: Wear steel-toed footwear if large containers of cells are being handled.	
Engineering controls: Keep away from heat and open flames. Store in a cool, dry place.			

Safety and Regulatory Information and Specifications

Safety considerations

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<p>Leak and spill procedure: Evacuate area if fire present or likely. Wear SCBA for fire-related emergencies. Using gloves, pick up or sweep up fire-damaged cells, bag individually in plastic bags and place in closed metal containers. 205 Litre lined steel drums are appropriate. Cardboard boxes may be used for small quantities. Avoid raising dust while sweeping. Transport container outdoors. Hold burned cells and fire cleanup solids for disposal as potential hazardous waste. Unburned cells are not hazardous waste. A fire with over 100 kg of cells burnt will likely require reporting to environment officials. Always consult and obey all international, federal and local environmental laws.</p>	
<p>Waste disposal: Always consult and obey all international, federal, provincial/state and local hazardous waste disposal laws. Some jurisdictions require recycling of this spent product.</p>	
<p>Handling procedures and equipment: Store in a cool, dry place away from sparks and flame. Keep below 125 °C. Keep above -60 °C. Charge between 0 °C and 45 °C. Use only approved charging equipment. Do not disassemble battery or battery pack. Do not puncture, crush or dispose of in fire.</p>	
<p>Storage requirements: Store at room temperature for best results.</p>	
<p>Special Shipping Information: Not regulated. This product is made from materials with no detectable mercury. Equivalent lithium content as per Section 38.3.2 of the UN Manual of Tests and Criteria (ST/SG/AC.10/11/27 Add. 2): Equivalent grams of lithium is equal to 0.3 times the rated Amp-hour capacity of the individual cell, regardless of cell size. 1.8 Ah = 0.54 g 2.0 Ah = 0.60 g 2.2 Ah = 0.66g 2.4 Ah = 0.72 g</p>	
<p>SECTION 8 - FIRST AID MEASURES</p>	
<p>Skin:</p>	<p>Not a health hazard.</p>
<p>Eyes:</p>	<p>Not an eye hazard</p>
<p>Inhalation:</p>	<p>Not an inhalation hazard.</p>
<p>Ingestion:</p>	<p>If swallowed, seek emergency medical aid. If patient choking and can partially breathe, encourage patient to cough. Do not strike patient's back. This may lodge cell further in throat. If patient is not breathing, perform standing Heimlich manoeuvre until object is dislodged or patient becomes unconscious. An unconscious patient should be lowered gently to the floor on their back and abdominal thrusts performed continuously until cell is ejected from throat or medical aid arrives.</p>

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SECTION 9 - PREPARATION INFORMATION			
Prepared by: Martin RIDGWAY, B.Sc. Safety Co-ordinator	Phone: (604) 466-6654	Date Created: Mar 31, 1995	Revision Information: First Issue
		Date Last Revised: Jul 31, 1998	Revision Information: Assign document control number. Company name change.
		Date Last Revised: Jun 15, 2000	Revision Information: Company name change.
		Date Last Revised: Jan 23, 2001	Revision Information: Shipping: Contains no mercury.
		Date Last Revised: May 1, 2001	Revision Information: Incompatibilities – Do not heat over 100C (to match UL warning statement)
		Date Last Revised: Jan 28, 2003	Revision Information: Shipping Information – Added equivalent lithium content information
		Date Last Revised: Feb 4, 2003	Revision Information: Product – Up to and including 2.4 Ah Ingredients - Added PS, LiCO ₂ and DTD Decomposition - Added sulphur compounds
Approval			

OTHER INFORMATION

The above information is believed to be correct but does not purport to be all-inclusive and shall be used only as a guide. Exact composition information is immediately available on a confidential basis to medical professionals treating exposure to cell components or combustion by-products.

HYDROFLUORIC ACID EXPOSURE DURING FIRE FIGHTING

This information is given for the use of professional fire fighters responding to a warehouse fire

Safety and Regulatory Information and Specifications

Safety considerations

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where fire from other materials may incinerate Molicels. This section is provided solely in case of exposure, during fire fighting, to the combustion by-products. Hydrofluoric acid is not present in the product. Contact with Molicels causes none of the following symptoms.

Hydrofluoric acid is extremely corrosive. Contact with hydrogen fluoride fumes is to be avoided. Permissible exposure limit is 3 ppm. In case of contact with hydrogen fluoride fumes, immediately leave the area and seek first aid and emergency medical attention. Symptoms may have delayed onset. Fluoride ions penetrate skin readily causing destruction of deep tissue layers and even bone. Fluoride interferes with nerve impulse conduction causing severe pain or absence of sensations. Immediately flush eyes or skin with water for at least 20 minutes to neutralize the acidity and remove some fluoride. Remove and destroy all contaminated clothing and permeable personal possessions. Before re-use, impermeable possessions should be soaked in benzalkonium chloride after water washing. Following flushing of the affected areas, an iced aqueous solution of benzalkonium chloride or 2.5 % calcium gluconate gel should be applied to react with the fluoride ion. Compresses and wraps may be used for areas where immersion is not practical. Medicated dressing should be changed every 2 minutes. Exposure to hydrofluoric acid fumes sufficient to cause pain requires immediate hospitalization for monitoring for pulmonary edema.

Certification and Compliance Statements

Certification


Agilent Technologies certifies that this product met its published specifications at the time of shipment from the factory. Agilent further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

Manufacturer's Declaration

This product has been designed and tested in accordance with the standards listed on the Manufacturer's Declaration of Conformity, and has been supplied in a safe condition. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.


Safety and Regulatory Information and Specifications
Certification and Compliance Statements

Declaration of Conformity for Agilent E7495A

DECLARATION OF CONFORMITY	
According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014	
Manufacturer's Name:	Agilent Technologies, Inc.
Manufacturer's Address:	1400 Fountaingrove Parkway Santa Rosa, CA 95403-1799 USA
Declares that the products	
Product Name:	Base Station Test Set
Model Number:	E7495A
Product Options:	This declaration covers all options of the above products.
Conform to the following product standards:	
EMC: IEC 61326:1997+A1:1998+A2:2000/ EN 61326:1997+A1:1998+A2:2001	
<u>Standard</u>	<u>Limit</u>
CISPR 11:1997 / EN 55011:1998/A-1999	Group 1, Class A
IEC 61000-4-2:1995+A1998 / EN 61000-4-2:1995	4 kV CD, 8 kV AD
IEC 61000-4-3:1995 / EN 61000-4-3:1995	3 V/m, 80 - 1000 MHz
IEC 61000-4-4:1995 / EN 61000-4-4:1995	0.5 kV sig., 1 kV power
IEC 61000-4-5:1995 / EN 61000-4-5:1996	0.5 kV L-L, 1 kV L-G
IEC 61000-4-6:1996 / EN 61000-4-6:1998	3 V, 0.15 - 80 MHz
IEC 61000-4-11:1994 / EN 61000-4-11:1998	1 cycle, 100%
Safety: IEC 61010-1:1990 + A1:1992 + A2:1995 / EN 61010-1:1993 + A2:1995 CAN/CSA-C22.2 No. 1010.1-92	
Supplementary Information:	
The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.	
	
Santa Rosa, CA, USA	19 December, 2002
Greg Pfeiffer/Quality Engineering Manager	
For further information, please contact your local Agilent Technologies sales office, agent or distributor.	

Rev. A 12/19/2002

Declaration of Conformity for Agilent E7495B

DECLARATION OF CONFORMITY	
<small>According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014</small>	
Manufacturer's Name:	Agilent Technologies, Inc.
Manufacturer's Address:	1400 Fountaingrove Parkway Santa Rosa, CA 95403-1799 USA
Declares that the products	
Product Name:	Base Station Test Set
Model Number:	E7495B
Product Options:	This declaration covers all options of the above products.
Conform to the following product standards:	
EMC: IEC 61326:1997+A1:1998+A2:2000/ EN 61326:1997+A1:1998+A2:2001	
<u>Standard</u>	<u>Limit</u>
CISPR 11:1997 / EN 55011:1998/A-1999	Group 1, Class A
IEC 61000-4-2:1995+A1998 / EN 61000-4-2:1995	4 kV CD, 8 kV AD
IEC 61000-4-3:1995 / EN 61000-4-3:1995	3 V/m, 80 - 1000 MHz
IEC 61000-4-4:1995 / EN 61000-4-4:1995	0.5 kV sig., 1 kV power
IEC 61000-4-5:1995 / EN 61000-4-5:1996	0.5 kV L-L, 1 kV L-G
IEC 61000-4-6:1996 / EN 61000-4-6:1998	3 V, 0.15 - 80 MHz
IEC 61000-4-11:1994 / EN 61000-4-11:1998	1 cycle, 100%
Safety: IEC 61010-1:1990 + A1:1992 + A2:1995 / EN 61010-1:1993 +A2:1995 CAN/CSA-C22.2 No. 1010.1-92	
Supplementary Information:	
The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.	
 Paul Forrest/Quality Engineering Manager	
Santa Rosa, CA, USA 26 September 2003	
For further information, please contact your local Agilent Technologies sales office, agent or distributor.	

Rev. A

Safety and Regulatory Information and Specifications Certification and Compliance Statements

Compliance with German Noise Requirements

This is to declare that this test set is in conformance with the German Regulation on Noise Declaration for Machines (Laermangabe nach der Maschinenlaermverordnung –3 GSGV Deutschland).

Acoustic Noise Emission/Geraeuschemission

LpA <70 dB	LpA <70 dB
Operator Position	am Arbeitsplatz
Normal Position	normaler Betrieb
per ISO 7779	nach DIN 45635 t. 19

Compliance with Canadian EMC Requirements

This ISM device complies with Canadian ICES-001.

Cet appareil ISM est conforme a la norme NMB du Canada.

Disposal of Batteries



Regulations vary for different countries. Dispose of in accordance with local regulations.

E7495A/B Base Station Test Set Specifications

Specifications describe the test set's warranted performance and are valid over the entire operating/environmental range unless otherwise noted. The specifications apply to version A.04.00 of the firmware or later.

The E7495A/B Base Station Test Set has been tested to the specifications of IEC 529 “Degrees of Protection Provided by Enclosures (IP Code).” Using this standard, the E7495A/B is rated IPX4.

Supplemental Characteristics are intended to provide additional information useful in applying the test set by giving typical, but non-warranted performance parameters.

Characteristics and specifications are shown as follows:

- **Bold type** indicates a warranted, hard specification.
- Normal type indicates a nominal value. Nominal values are design center values and not normally tested during manufacturing.
- *Italics type* indicates a typical value. Typical performance is defined as 80% of the points over the specified range will meet or exceed the typical value.

Table 1 E7495A/B Base Station Test Set General Specifications

Unless otherwise noted, the following specifications apply to all measurements/tools using Port 2.

Frequency accuracy:

Using internal time base:	$\leq \pm 1 \text{ ppm}$ with > 15 minute warmup
Internal frequency aging	$\pm 1 \text{ ppm aging/year}$
With GPS lock or Even Second Sync lock for > 15 minutes:	$\leq \pm 0.03 \text{ ppm}$

Input frequency range:

10 MHz to 2700 MHz
 Usable to 500 kHz (specifications and typical values do not apply below 375 MHz unless otherwise noted)
 (Refer to individual measurement tools below for applicable frequency ranges.)

Maximum input level:

+ 20 dBm (.1 W), + 50 dBm with supplied attenuator

Safety and Regulatory Information and Specifications
E7495A/B Base Station Test Set Specifications

Table 1 E7495A/B Base Station Test Set General Specifications

Maximum input power without damaging instrument:	100 W (without external attenuator)
Frequency and time reference:	
Can use internal timebase or external signal:	
GPS (external antenna supplied) EVEN SECOND; PULSE	
1.000 MHz:	≥ 0 dBm
2.048 MHz:	≥ 0 dBm
4.950 MHz:	≥ 0 dBm
10.000 MHz:	≥ 0 dBm
13.000 MHz:	≥ 0 dBm
15.000 MHz:	≥ 0 dBm
19.6608 MHz:	≥ 0 dBm
Display:	
Scale:	1 to 20 dB / div. Settable in 1 dB increments.
Number of points:	256
Number of divisions:	10
40 dB Attenuator:	
Frequency range:	10 to 2500 MHz
Attenuation accuracy:	±0.5 dB
Max power:	50 dBm (100 W)
Spectrum Analyzer / Tools	
Input frequency range:	10 mHz to 2700 MHz (usable to 500 kHz)
Reference level range:	-150 to +100 dBm
Dynamic range:	+50 dBm to -150 dBm (with supplied external 40 dB attenuator) (30 Hz RBW)
Input attenuation:	0 to 30 dB automatically selected. 10 dB controllable manually.

Table 1 E7495A/B Base Station Test Set General Specifications

Amplitude accuracy:	± 1 dB (100 MHz – 2500 MHz at 25 °C)
Resolution bandwidth:	10 Hz to 1 MHz, settable to 1 Hz precision
Span:	1 kHz to 2.6995 GHz
Trace update:	
Span:	2.6995 GHz (autocouple) = 5.1 seconds 60 MHz (autocouple) = 400 ms 1 MHz (100 Hz RBW) = 1.2 seconds
Simultaneous dynamic range:	> 90 dB (CW signals at 300 kHz separation, span 500 kHz, 30 Hz RBW)
SSB phase noise:	≤ -85 dBc (30 kHz offset)
Spurious responses:	
Range control set to auto, high sensitivity mode internally generated	
50 ohm load on input:	< -115 dBm
Crossing spurs:	≤ -50 dBc
Displayed average noise level:	-150 dBm (30 Hz RBW, 375 MHz to 1.5 GHz)
Port 2 VSWR:	$< 2:1$

Antenna/Cable Analyzer^a

For each of the following measurements, a short self-calibration procedure must be run prior to making the measurement.

Frequency range:	375 to 2500 MHz
Frequency resolution:	< 500 Hz
Immunity to interfering signals:	+20 dBm (with interference rejection turned on)
Measurement speed:	
Full span:	< 17 ms
60 MHz span:	< 7 ms

Safety and Regulatory Information and Specifications
E7495A/B Base Station Test Set Specifications

Table 1 E7495A/B Base Station Test Set General Specifications

Return loss (Port 1):
 With ≥ 16 averages and 375 MHz to 2200 MHz

Range:	<i>> 40 dB</i>
VSWR:	<i>< 1.02</i>
Resolution:	0.1 dB
Display range:	-5 to +150 dB
SWR range:	1 to 500

Insertion loss (Port 1 to Port 2):

Measurement uses supplied 10 dB pads.

Usable range:	<i>> 100 dB wide range mode</i>
Accuracy:	± 1 dB (over 0 to 60 dB, ≥ 16 averages)
Readout resolution:	± 0.1 dB
Average insertion loss (readout) accuracy: ± 0.1 dB for	± 0.1 dB; for Range - 0 to 40 dB, Frequency (mobile phone bands) - 824 to 960 MHz, 1710 to 2170 MHz

Distance to Fault (Port 1):

Range (m):	1 m to 300 m
Resolution:	$(1.5 \times 10^8) (V_f)/(f_2 - f_1)$ Hz where V_f is relative propagation velocity of the cable. Typically 1% of measurement distance
VSWR:	1 to 500
Number of Data Points	256, 512, 1024

a. See [Table 2](#) on page 541

Table 2 Example Table Illustrating the Effects of Data Points and Span versus Measured Distance and Resolution (Vf of 93.1%)

Data Points	Span	Measured Distance	Resolution
256	140 MHz	127.68 m	50 cm (19.6 inch)
512	140 MHz	255.36 m	50 cm (19.6 inch)
512	280 MHz	127.68 m	25 cm (9.8 inch)
1024	560 MHz	127.68 m	12.5 cm (4.9 inch)

Table 3 E7495A/B Base Station Test Set Option Specifications

cdmaOne / CDMA2000 1X Analyzer Option 200

Waveform quality accuracy (rho):	± 0.005 for $0.9 < p < 1.0$ (min. power at RF input > -85 dBm)
Pilot time alignment (tau):	± 500 nSec
Code domain power accuracy:	± 1.5 dBm absolute, ± 0.5 dB relative (> -20 dB)
Pilot power:	± 1.5 dB

CDMA2000 1xEV-DO Analyzer Option 205

Waveform quality accuracy (rho):	± 0.008 for $0.9 < p < 1.0$ (min. power at RF input > -70 dBc)
Frequency Error:	± 20 Hz (with freq/time reference set to External Even Second or GPS)
Pilot time alignment (tau):	± 500 nSec
Code domain power accuracy:	± 1.5 dBm absolute, ± 0.5 dB relative (> -20 dB)
Pilot + MAC power:	± 1.5 dB

Safety and Regulatory Information and Specifications
E7495A/B Base Station Test Set Specifications

Table 3 E7495A/B Base Station Test Set Option Specifications

RF Channel Scanner Option 220 (includes adjacent channel power)	
Measurement range	+20 dBm to -125 dBm > 375 MHz, 10 kHz RBW (up to +50 dBm with external attenuator)
Frequency readout accuracy:	Timebase accuracy +3 Hz + 1 / (measurement time X duty cycle)
Frequency range:	10 MHz to 2700 MHz
RF channel power:	± 1 dB (100 to 2500 MHz)
Adjacent channel power accuracy:	± 0.75 dBc
GSM Analyzer Option 230	
Frequency range:	100 MHz to 2500 MHz (usable to 10 MHz)
RF channel power:	± 1 dB (0 to -70 dBm)
Phase error floor:	< 2.5 degrees RMS
Phase error accuracy:	< 1 degree RMS, 2 degrees ≤ Phase Error ≤ 15 degrees
Frequency error accuracy:	± 40 Hz with external reference
W-CDMA (UMTS) Option 240	
Error Vector Magnitude (EVM): Conditions:	Resolution 0.1%; residual error <6% Min power at RF input > -65 dBm, 3GPP test model 4
Code Domain Power Accuracy:	±0.5 dB (for code channel power > -25 dB relative to total power, using test model 1 (with 16 DPCH, 32 DPCH, and 64 DPCH), test model 2 and test model 3 (with 16 DPCH and 32 DPCH))
Scrambling Code Determination	1 second (in auto mode)
Code Domain Power display update	1.5 second
DC Bias Option 300 (Port 1) E7495B only	

Table 3 E7495A/B Base Station Test Set Option Specifications

DC Voltage:	<i>+12.7 VDC maximum</i>
DC Current:	<i>800 mA maximum</i>
Volt-Amps:	<i>9.84 VA maximum</i>

Signal Generator (CW) Option 500 (Port 1)

Frequency range:	375 to 2500 MHz
Output level:	<i>-23 to -95 dBm</i>
Level accuracy:	<i>± 1 dB between -25 to -85 dBm</i>
Phase error:	<i>At 30 KHz offset -90 dBc/Hz</i>

cdmaOne / CDMA2000 1X / CDMA2000 1xEV-DO (requires Option 205) Reverse Link Signal Generator Option 510 (port 1)

Frequency range:	375 to 2500 MHz
Output level (E7495A):	<i>-50 to -95 dBm</i>
Output level (E7495B):	<i>-28 to -95 dBm</i>
Level accuracy:	<i>± 1.5 dB (-50 dBm to -90 dBm)</i> <i>± 2 dB (>-50 dBm)</i>

Power Meter Option 600

Display

Range:	-100 dBm to +100 dBm
Limits:	± -100 dBm
Resolution:	Settable 1.0, 0.1, 0.01, 0.001 in logarithmic mode or 1, 2, 3, or 4 significant digits in learner mode.

Safety and Regulatory Information and Specifications
E7495A/B Base Station Test Set Specifications

Table 3 E7495A/B Base Station Test Set Option Specifications

Instrumentation Accuracy:	
Absolute:	± 0.02 dB (log) or $\pm 0.5\%$ (linear) Add the corresponding power sensor linearity percentage.
Relative:	± 0.04 dB (log) or $\pm 1.0\%$ (linear) Add the corresponding power sensor linearity percentage.
Zero set accuracy:	Zero set is the digital zero with an 8482A sensor ± 50 nW
Power reference accuracy:	
Power output:	1.00 mW (0.0 dBm) traceable to the U.S. National Institute of Standards and Technology (NIST).
Accuracy:	$\pm 1.2\%$ worst case ($\pm 0.9\%$ rss) for one year
VSWR:	< 1.08
External attenuator:	
Max power:	100 watts
Attenuation:	40 dB ± 0.5 dB
Power meter Option 600 with Agilent 8482A power sensor (also supports Agilent 8481A power sensor)	
Frequency Range:	100 kHz to 4.2 GHz
VSWR	
100 kHz to 1 MHz:	< 1.60
0.3 MHz to 1 MHz:	< 1.20
1 MHz to 2 GHz:	< 1.10
2 GHz to 4.2 GHz:	< 1.3
Power linearity:	+ 10 dBm to +20 dBm; $\pm 3\%$
Maximum power:	300 mW average. 1 W peak, 30 W - μsec per pulse
Measurement noise:	< 93.5 nW (0.85 + 110 nW)
Average filtering:	Fixed at 32 in normal mode
Zero drift:	< ± 10 nW

Table 3 E7495A/B Base Station Test Set Option Specifications

T1 Analyzer Option 700

Receive level (line 1 and line 2): +6 dB DSC to -36 dB DSX or 100 mv peak-to-peak to 12 V peak-to-peak

Receive frequency (line 1 and line 2) display receive frequency (5 ppm) "Loopback" control send CSU or NIU loop codes CSU/NIU emulation respond to CSU or NIU loop codes

Electrical interface:

Connectors, Rx, Tx: Primary and secondary ports
 Output: Conforms to TR-TSY-000499, CCITT Rec.G.703 AT&T Pubs CB113, CB119, CB132, CB143 PUB62508 and PUB62411 pulse shape specifications when terminated in 100 ohms and 0 dB line build-out is selected

Line build out Input: 0 dB, -7.5, -15 dB

Terminate: DSX +6 dB to DSX -36 dB, 100 ohms
 Monitor: DSX -14 dB to DSX -40 dB, 100 ohms
 Bridge: DSX + 6 dB to DSX -36 dB, > 1000 ohms

Clock: 1.544 MHz

Internal: ± 5 ppm
 External: ± 300 ppm
 Recovered: ± 300 ppm

Transmitter and receiver:

Framing: Unframed: D3 / D4 and ESF
 Channel formats: Full T1, 64 X 1

Test patterns: QRSS, all Os, 1:7, 2 in 8, 3 in 24, all 1s, T-1-Daly, 55 OCTET

Error injection type: BPV, frame, CRC, pattern (logic)
 Error rate: Single
 Alarm inject type: LOS, LOF, yellow, AIS, idle (CDI)

Safety and Regulatory Information and Specifications
E7495A/B Base Station Test Set Specifications

Table 3 E7495A/B Base Station Test Set Option Specifications

E1 Analyzer Option 710	
Error detect:	Code (BPV), FAS, MFAS, CRC-4, Far End Block (FEBE), Pattern, Fame Slip
Error rate calculation:	Bit-Error-Rate, Error Free Seconds, Errored seconds
Alarm detect:	AIS, TS-16 AIS, FAST DISTANT, MFAS DISTANT
Clock and frame slips:	Clock Slips, Frame slips, Peak Wander, Clock slip rate
Auto configuration:	Automatically detect line code, framing and test pattern
Receive level (line 1 and line 2):	+6 dB DSX to -36 dB DSX or 100 mv p-to-p to 12 v p-to-p
Receive frequency (line 1):	Display receive frequency (± 5 ppm)
Channel access:	Output audio to system
Delay measurement:	Measure delay in unit intervals for "looped-back" signal
Electrical Interface:	
Connectors, Rx, Tx:	Primary and secondary ports
Output:	Conforms to ITU-T Rec.G.703
Line code:	AMI, HDB3
Impedance:	Terminate: 75 ohms $\pm 5\%$ Bridge: > 1000 ohms
Input:	Terminate: DSX +6 dB to DSX -36 dB
Bridge:	DSX +6 dB to DSX -36 dB
Clock:	2.048 MHz
Internal:	± 5 ppm
External:	± 300 ppm
Recovered:	± 300 ppm
Transmitter and receiver	
Framing:	Unframed, PCM-30, PCM-30 with CRC, PCM-31, PCM-31 with CRC
Channel Formats:	Full E1, 64x1

Table 3 E7495A/B Base Station Test Set Option Specifications

Test Patterns:	(True or Inverse, ITU Rec) 2^6-1 (Q6&Q5), 2^9-1 (V.52), $2^{11}-1$ (0.152), $2^{15}-1$ (0.151) $2^{20}-1$ (V.57), QRSS, $2^{23}-1$ (0.151), All 0's, 1:7, 1:3, 1:1, All 1's
Error injection	
Type:	Code (BPV), FAS, MFAS, CRC-4, Far End Block (FEBE), Pattern
Error rate:	Single Alarm generation AIS, TS-16 AIS, FAS DISTANT, MFAS DISTANT, Loss of signal, Loss of Frame

Table 4 E7495A/B Base Station Test Set General Specifications

Display:	Transflective VGA and color LCD
Dimensions	
Height:	11.6", 295 mm
Width:	14.5", 368 mm
Depth:	5.3", 135 mm
Weight (without batteries):	20 lbs, 9.1 kg
Power supply:	
Internal:	<i>Lithium Ion battery: 10.8 volts, 6.0 Ah (1 NI2040AG shipped standard, will accept 2 batteries)</i>
External:	DC Input +9 V to +25 V dc (55 Watts)
Battery life:	<i>Approximately 1.5 hour per battery (time varies depending upon instrument mode)</i>

Safety and Regulatory Information and Specifications
E7495A/B Base Station Test Set Specifications

Table 4 E7495A/B Base Station Test Set General Specifications

Interface Ports:	Two RS 232 (DB-9) (reserved for future use) Two USB 1.1 (reserved for future use) One LAN Port 10 Base T Built-in speaker PCMCIA Card slot CompactFlash memory (type 1 & 2) Stereo headphone jack General purpose input/output - TTL level (reserved for future use)
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Inputs

Port 2 RF in:	50 ohm type N
External DC input:	+9 V to + 25 V DC (55 Watts)
Frequency reference:	
Input power:	<i>-10 to + 10 dBm</i>
Connector:	<i>50 ohm BNC</i>
Even second:	
Connector:	<i>High impedance BNC</i>
Level:	<i>TTL compatible</i>
GPS antenna:	
Connector:	SMA
Output:	5 V at 50 mA
Outputs:	
Port 1 RF Out/SWR Connector:	<i>50 ohm type N</i>
Power reference:	<i>50 ohm type N; SWR < 1.06</i>

Table 4 E7495A/B Base Station Test Set General Specifications

Optional Connectors:

Option 600 power meter:

Outputs:	50 ohm type N power reference
Inputs:	Sensor input for 8480 series sensors

Option 700 T1 analyzer:

Out puts:	(2) Bantum outputs; Tx primary and secondary
Inputs:	(2) Bantum inputs; Rx primary and secondary

Option 710 E1 analyzer:

Outputs:	(2) 75 ohm BNC outputs; Tx primary and secondary
Inputs:	(2) 75 ohm BNC inputs; Rx primary and secondary

Operating temperature specified range:	<i>-10 ° to 50 °C; 14 ° to 122 °F</i>
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Storage temperature:	<i>-40 ° to 70 °C; -40 ° to 158 °F</i>
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Calibration Cycle:	1 year
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Warranty Duration:	1 year
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Safety and Regulatory Information and Specifications

E7495A/B Base Station Test Set Specifications

Battery Pack Specifications



Product Safety Data Sheet

PRODUCT NAME: Inspired Energy Rechargeable Battery Pack Model: NI2040AG Rev2
ALTERNATE NAME: 1420-0883
TRADE NAME: NI2040AG Rev 2 / NI2040AG2 Volts: 10.8
CHEMICAL SYSTEM: Lithium Ion Approximate Weight: 484 g
Date Prepared: November 13thth 2002 Updated April 7th 2003

SECTION I – MANUFACTURER INFORMATION

Inspired Energy, Inc.
12705 N US Hwy 441
Alachua, FL 32615
Telephone: (888) 5-INSPIRE (888-546-7747)

SECTION II – HAZARDOUS INGREDIENTS

Important Note:

The battery should not be opened or burned. Exposure to the ingredients contained within or their combustion products could be harmful.

Please refer to the attached cell Material Safety Data Sheet Filename: MSDS Moll 18650 up to 2400mAh.pdf

SECTION III – OPERATING PARAMETERS

Maximum Charge Voltage: 12.6 V
Minimum Charge Voltage: 7.5 V
Maximum Charge Current: 3.0 A
Maximum Discharge Current: 6.0 A

Recommended Charging Method: Use an Agilent approved charger to provide a 3.0 A current limited constant voltage of 12.6 V. The charging cycle will terminate when the average current falls below 150mA.

The information contained within is provided for your information only. This battery is an article pursuant to 29 CFR 1910.1200 and, as such, is not subject to the OSHA Hazard Communication standard requirement for preparation of a material safety data sheet. The information and recommendations set forth herein are made in good faith and are believed to be accurate as of the date of preparation. However, INSPIRED ENERGY, INC. MAKES NO WARRANTY, EITHER EXPRESSED OR IMPLIED, WITH RESPECT TO THIS INFORMATION AND DISCLAIMS ALL LIABILITY FROM RELIANCE ON IT.

Inspired Energy, Inc. 12705 US Hwy 441 N, Alachua, FL 32615
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www.inspired-energy.com

“Using, Inspecting, and Cleaning RF Connectors” on page 552

“Repeatability” on page 552

“RF Cable and Connector Care” on page 552

“Proper Connector Torque” on page 553

“Connector Wear and Damage” on page 554

“Cleaning Procedure” on page 554

Using, Inspecting, and Cleaning RF Connectors

Taking proper care of cables and connectors will protect your test set's ability to make accurate measurements. Inaccurate measurements often result from improperly made connections or dirty or damaged connectors.

Worn, out-of-tolerance, or dirty connectors degrade the accuracy and repeatability of measurements. For more information on connector care, refer to the documentation that came with your calibration kit.

Repeatability

If you make two identical measurements with your test set, the differences should be so small that they do not affect the value of the measurement. Repeatability (the amount of similarity from one measurement to another of the same type) can be affected by:

- Dirty or damaged connectors
- Connections that have been made without using proper torque techniques (this applies primarily when connectors in the test set have been disconnected, then reconnected)

CAUTION

This test set contains test sets and devices that are static-sensitive. Always take proper electrostatic precautions before touching the center conductor of any connector, or the center conductor of any cable that is connected to the test set.

RF Cable and Connector Care

Connectors are the most critical link in a precision measurement. These devices are manufactured to extremely precise tolerances and must be used and maintained with care to protect the measurement accuracy and repeatability of your test set.

To Extend the Life of Your Cables or Connectors:

- Avoid repeated bending of cables—a single sharp bend can ruin a cable instantly.
- Avoid repeated connection and disconnection of cable connectors.
- Inspect the connectors before connection; look for dirt, nicks, and other signs of damage or wear. A bad connector can ruin the good connector instantly.

- Clean dirty connectors. Dirt and foreign matter can cause poor electrical connections and may damage the connector.
- Minimize the number of times you bend cables.
- Never bend a cable at a sharp angle.
- Do not bend cables near the connectors.
- If any of the cables will be flexed repeatedly, buy a back-up cable. This will allow immediate replacement and will minimize your test set's down time.

Before Connecting the Cables to Any Device:

- Check all connectors for wear or dirt.
- When making the connection, torque the connector to the proper value.

Proper Connector Torque

- Provides more accurate measurements
- Keeps moisture out the connectors
- Eliminates radio frequency interference (RFI) from affecting your measurements

The torque required depends on the type of connector. Refer to [Table 21-1](#). Do not overtighten the connector.

CAUTION

Never exceed the recommended torque when attaching cables.

Table 21-1 Proper Connector Torque

Connector	Torque cm-kg	Torque N-cm	Torque in-lbs	Wrench part number
Type-N	52	508	45	8710-1935
3.5 mm	9.2	90	8	8710-1765
SMA	5.7	56	5	8710-1582

Connector Care

Using, Inspecting, and Cleaning RF Connectors

Connector Wear and Damage

Look for metal particles from the connector threads and other signs of wear (such as discoloration or roughness). Visible wear can affect measurement accuracy and repeatability. Discard or repair any device with a damaged connector. A bad connector can ruin a good connector on the first mating. A magnifying glass or jeweler's loupe is useful during inspection.

Cleaning Procedure

1. Blow particulate matter from connectors using an environmentally-safe aerosol such as Ultrajet. This product is recommended by the United States Environmental Protection Agency and contains chlorodifluoromethane.
2. Use an alcohol wipe to wipe connector surfaces. Wet a small swab with alcohol (from the alcohol wipe) and clean the connector with the swab.
3. Allow the alcohol to evaporate off the connector before making connections

CAUTION

Do not allow excessive alcohol to run into the connector. Excessive alcohol entering the connector collects in pockets in the connector's internal parts. The liquid will cause random changes in the connector's electrical performance. If excessive alcohol gets into a connector, lay it aside to allow the alcohol to evaporate. This may take up to three days. If you attach that connector to another device it can take much longer for trapped alcohol to evaporate.

“Installing Batteries” on page 556

“Viewing Battery Status” on page 557

“Charging Batteries” on page 560

“Reconditioning Batteries” on page 562

“Battery Care” on page 565

“Battery Specifications” on page 568

Installing Batteries



Step	Notes
1	Open the battery door. Turn the latch counterclockwise several times until loose. Then pull the battery door open.
2	Insert the battery. Insert one or two batteries.
3	Close the battery door. Turn the latch clockwise until tight to secure the battery door.

Viewing Battery Status

You can view information about battery status in four ways:

- Two battery LEDs embedded in the E7495A/B enclosure
- Icons in the lower right of the front panel screen
- System Statistics—Battery screen, available from the System menu
- LCD gauge built into each battery

Battery LEDs

LED	Charge remaining
Green	Greater than or equal to 25% charge capacity remaining
Blinking green	Battery charging
Green and red (may appear yellow or orange)	Greater than or equal to 10% and less than 25% charge capacity remaining
Red	Less than 10% charge capacity remaining

NOTE

The battery status LEDs will function only when the test set is on, in standby mode, or connected to external power.

Front Panel Icons

Icon	Status
Plug icon	Connected to external power through AC adapter converter or car adapter
2 solid batteries	2 batteries installed
1 solid battery	1 battery installed

Working with Batteries

Viewing Battery Status

Icon	Status
% displayed beneath battery	Amount of charge capacity remaining for battery

System Statistics—Battery Screen

Step	Notes
1 System	
2 [More 1 of 2]	
3 [Battery]	

The Battery screen displays several kinds of information:

- **Temperature**—the internal temperature of each battery as measured by a sensor embedded in each battery
- **Voltage**—for each battery cell stack as measured by each battery’s sensor
- **Run Time to Empty**—while using external power, External DC Power is displayed; while using battery power, the predicted remaining battery run time is displayed in minutes at the present rate of discharge. If two batteries are installed, the second battery will have Not in Use displayed. The instrument mode you select affects the discharge rate, which determines the run time to empty. Antenna/Cable, Spectrum Analyzer, CDMA Tx Analyzer, and CDMA Over Air modes use the most power. Backhaul and Power Meter modes use the least power.
- **Fuel Gauge Error**—the present accuracy of each battery’s fuel gauge or remaining charge capacity. If the error exceeds 10%, you should condition the battery.
- **Percent Charged**—the predicted charge capacity of each battery in percent.
- **Battery Status**—For Battery 1 and Battery 2, Present or Missing tells you whether a battery is installed.

Built-In Battery Gauge

Each Lithium Ion battery has a five-segment LCD gauge that displays its charge

status. Each segment represents 20% of the charge capacity. The gauge is active unless the battery is in shutdown mode. You can view the gauge with the door open.

Gauge	Charge Remaining
5 segments	81-100%
4 segments	61-80%
3 segments	41-60%
2 segment	21-40%
1 segment	1-20%
0 segment	Less than 1%

Charging Batteries

You can charge batteries internally or using the external battery charger (Option #820). The external charger provides much faster charging time.

CAUTION

Charge batteries internally or with the appropriate charger, a SMBus charger of level II or higher.

Never use a non-SMBus charger because the battery issues commands over the SMBus to the charger to control the charge rate and voltage.

Never use a modified or damaged charger.

Internal Charging

You can use the E7495A/B to recharge while the test set is operating or shut down. For a fully depleted battery, charging time is approximately 4 hours if the test set is shut down, 8 hours if the test set is operating.

If two batteries are installed, the test set fully charges Battery 1 before charging Battery 2. During internal charging, the charge indicator blinks to indicate which battery is being charged.

To charge a battery internally, simply attach the car adapter or AC adapter and turn on external power.

External Charging

The external battery charger (available as part of Option 820) lets you charge two batteries simultaneously. Each fully depleted battery takes up to 4 hours to recharge.

You have the option of charging batteries before they become fully depleted. Doing this does not shorten battery life, but repeatedly charging a battery before it is fully discharged will impair the accuracy of its internal charge-remaining indicator. When the fuel gauge error is greater than 10%, the battery should be reconditioned.

External Battery Charger LED	Charging Status
Green on	Fully charged
Green flashing	Fast charging

External Battery Charger LED	Charging Status
Yellow flashing	Reconditioning—the accuracy of the battery’s internal LCD charge gauge is being renewed. See “Reconditioning Batteries.”
Yellow/green	Battery is reconditioned
Red flashing	Error
Yellow on	Standby

Reconditioning Batteries

Each battery contains a microchip that monitors battery usage and tracks how much capacity is available. This function can become less accurate because of temperature fluctuations, aging, self-discharge, repeated partial charging, and other factors. This inaccuracy is displayed on the System Statistics—Battery screen as Fuel Gauge Error.

To ensure the accuracy of the battery's internal capacity tracking system, occasionally you need to recalibrate the battery. Reconditioning—also known as recalibrating—is done by fully charging the battery, fully discharging it, recharging it again, and then verifying that the error has been corrected.

You can recondition a battery internally or with the external charger. The charger makes the process simpler.

Determining if a Battery Needs Reconditioning

Step	Notes
1	System
2	[More 1 of 2]
3	[Battery] On the Battery screen, if the error percentage for the battery is greater than 10%, the battery needs to be reconditioned.

NOTE

After reconditioning, if the battery is not fully charged or still shows more than a 10% Fuel Gauge Error reading, repeat the reconditioning procedure. If the second reconditioning does not restore a full charge and give an error reading of 10% or less, the battery needs replacement. This error will affect all of the displayed battery charge indicators.

Internal Reconditioning

If you don't have the external battery charger, you can use the test set to recondition

a battery. The process takes longer and requires shutting down the test set.

Step	Notes
<p>1 Fully charge the battery.</p> <ul style="list-style-type: none"> a. Power off the test set. b. Install the battery needing reconditioning into the test set. If you have a second battery installed, remove the second battery. c. Connect the car adapter or AC adapter to the test set, and plug the other end of the adapter in the appropriate power source. 	<p>To fully charge the battery, leave the test set power off for approximately 4 hours.</p>
<p>2 Fully discharge the battery.</p> <ul style="list-style-type: none"> a. Disconnect the external power adapter, then power on the test set. b. Confirm that the battery now has 100% of its charge by checking the Battery 1 or Battery 2 status icon in the lower right of the display or the System Statistics—Battery screen. c. Run the test set without external power until you fully deplete the battery (approximately 1.5 hours). 	
<p>3 Charge the battery and verify a full charge.</p> <ul style="list-style-type: none"> a. Power off the test set again. b. Reconnect the external power adapter and charge the battery again for approximately 4 hours. c. Power on the test set. d. Confirm that the battery is fully charged and reconditioned by checking the System Statistics—Battery screen. 	<p>On the System Statistics—Battery screen, the battery should show 100% charge rate and less than a 10% Fuel Gauge Error.</p>

Working with Batteries

Reconditioning Batteries

Reconditioning with the External Battery Charger

Step	Notes
1 Insert a battery into the left bay of the external battery charger.	
2 Press the blue button labeled Push to Recalibrate Left Battery Bay .	The charger will charge the battery fully, discharge it completely, then recharge it fully again. The entire process can take up to 10 hours.
3 Install the battery into the test set.	
4 On the System Statistics—Battery screen, verify that the battery is fully charged and reconditioned.	

WARNING

If you are charging the batteries internally, even while the test set is powered off, the test set may become warm. Take care to provide proper ventilation.

Battery Care

WARNING

Lithium Ion and lithium polymer cells and battery packs may get hot, explode, or ignite and cause serious injury if exposed to abuse conditions. Be sure to follow these safety warnings:

- Do not install the battery backward, so the polarity is reversed.
- Do not connect the positive terminal and negative terminal of the battery to each other with any metal object (such as wire).
- Do not carry or store the battery with necklaces, hairpins, or other metal objects.
- Do not pierce the battery with nails, strike the battery with a hammer, step on the battery, or otherwise subject it to strong impacts or shocks.
- Do not solder directly onto the battery.
- Do not expose the battery to water or salt water, or allow the battery to get wet.
- Do not disassemble or modify the battery. The battery contains safety and protection devices, which, if damaged, may cause the battery to generate heat, explode, or ignite.
- Do not place the battery in or near fire, on stoves, or in other high temperature locations. Do not place the battery in direct sunlight, or use or store the battery inside cars in hot weather. Doing so may cause the battery to generate heat, explode, or ignite. Using the battery in this manner may also result in a loss of performance and a shortened life expectancy.
- Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended. Discard used batteries according to manufacturer's instructions.

WARNING

Do not discharge the battery using any device except the specified device. When the battery is used in devices other than the specified device, it may damage the battery or reduce its life expectancy. If the device causes an abnormal current to flow, it may cause the battery to become hot, explode, or ignite and cause serious injury.

Maximizing Battery Life

The Lithium Ion battery used in the E7495A/B has a life span of approximately 300 charge cycles at room temperature, with normal charge and discharge rates. You can maximize the number of charge cycles with reasonable battery care:

- Clean the battery contacts occasionally, using a pencil eraser or alcohol and a cotton swab. Make sure no residue from the eraser or cotton swab is left on the contact points.
- Cycle each battery through a full charge and full discharge on a regular basis, preferably monthly. Even if you use external power most of the time, you will lengthen battery life by occasionally cycling through a full discharge/recharge cycle.
- Do not leave a battery unused for an extended period. Batteries that remain idle eventually lose their ability to hold a charge.
- Unplug the external battery charger (Option #820) when you're not using the test set.
- Store batteries in a cool, dry location, away from metal objects and corrosive gases. Extended exposure to high humidity or temperatures above 45 degrees Celsius (113 degrees Fahrenheit) can impair battery performance and shorten battery life. Storage limits are $-20\text{ }^{\circ}\text{C}$ to $60\text{ }^{\circ}\text{C}$ 80% RH.
- Allow a battery to warm to room temperature before charging it. Temperature shock can damage the battery chemistry and in some cases cause a short circuit.
- Always charge batteries at temperatures between 0 and 45 degrees Celsius (32 to 113 degrees Fahrenheit).
- Operate the test set on battery power between the temperatures of -10 and $+50$ degrees Celsius (-14 to $+122$ degrees Fahrenheit). Using the batteries at lower or higher temperatures can damage the batteries and reduce operating life. Cold temperatures affect battery chemistry, reducing charge capacity, especially below 0 degrees Celsius (32 degrees Fahrenheit).
- Batteries are shipped with a minimum of 20% charge capacity to provide at least

a 6-month shelf life at room temperature, before the battery electronics go into shutdown mode. When a battery has discharged down to a 7.1 volts, it goes into shutdown mode. When this occurs, the battery electronics self-disconnect, removing their electronic load from the cells. This provides approximately 1 year of room temperature storage before the cells self-discharge to the point beyond which they should not be recharged. Once a battery has reached shutdown mode the battery will undergo a self-test immediately upon being put into charge. The charger will then attempt to pre-charge the battery at a very low initial charge rate. If the voltage does not recover, the battery pack has been allowed to discharge beyond the point of safe recovery. The charge cycle will be terminated, and the battery pack needs to be replaced.

If the battery does recover from a shutdown mode, the fuel gauge accuracy will be reduced. Complete a battery recalibration as soon as possible to calibrate the fuel gauge.

Initial Charge Cycle

New batteries must be rapid-charged (typically to 80%), then trickle-charged (slowly charged to 100%) for 24 hours, before their first use and for the first two or three uses.

Because the batteries you receive with the E7495A/B are new, they have a minimal charge when you receive them. All batteries require a “break-in” period, so don't be alarmed if a battery doesn't hold a full charge right away. A new battery commonly will show a false full charge (voltage) as indicated on the test set or charger, and may not power up the test set upon first use. Before using a new battery, leave it charging for 24 hours.

Lithium Ion Battery Disposal

When you notice a large decrease in charge capacity after proper recharging, it's probably time to replace the battery.

Li-Ion batteries need to be disposed of properly. Contact your local waste management facility for information regarding environmentally sound collection, recycling, and disposal of the batteries. Regulations vary for different countries. Dispose of in accordance with local regulations.

Battery Specifications

The E7495A/B Base Station test set uses the Inspired Energy NI2040AG Smart Battery, which produces 10.8 volts DC at approximately 6000 mA. The NI2040AG is a Lithium Ion battery pack, which uses the System Management Bus (SMBus) interface to communicate with the test set and charger. To charge the batteries, use only the Agilent approved SMBus charger of Level II or higher or the E7495A/B.

External charging voltage is 18 V to 24 VDC.

The battery is designed for approximately 300 full charge/discharge cycles at room temperature and under normal rates of discharge.

The NI2040AG uses electronically programmable read-only memory (EPROM) to store key data regarding the battery cells and charge capacity.

Protection Electronics

The NI2040AG SMBus battery uses several protection devices to prevent damage to the battery and test set. The battery is internally protected against excessive current draws and reduced loads (shorts), excessive voltage and temperatures.

During charging and discharging, the battery will monitor and report its voltage, current, and temperature. If any of these monitored conditions exceeded their safety limits, the battery will terminate any further charge or discharge until the error condition is corrected.

Test Set Operation: Battery Current Drain in the Off or Standby Mode

The E7495A/B provides two “powered down” modes: off and standby.

When the test set is operating from battery power, it continues to draw current in both off and standby modes. When in standby mode the test set draws 70 mA, or 28% of a full battery charge in a 24-hour period. When in off mode, the test set draws 45 mA, or 18% of a full battery charge in a 24-hour period. Agilent recommends that if the test set is not going to be used for an extended period of time, you periodically check and maintain the batteries’ charge, or remove the batteries from your test set. This will ensure you have sufficient battery capacity if you intend to operate the test set from battery power.

Battery Drain when in Off and Standby Modes

- Single battery off mode: 18.46% or 1.08 amps per 24 hrs.
- Single battery standby mode: 28.72% or 1.68 amps per 24 hrs.

Battery and Charger Part Numbers

Standard Supplied Accessories

Description	Part Number
AC/DC Converter	0950-4404
NI2040AG Battery	1420-0883*

Optional Accessories provided in E7495A/B Option 820

Description	Part Number
Charger 12 V at 1 A	0950-4276
AC/DC Converter	0950-4404
Auto Adapter F1455A	0950-4412
NI2040AG Battery	
E7495A	1420-0883
E7495B	1420-0883

NOTE

* Replace only with NI2040AG or equivalent, Agilent-approved battery.

Additional batteries are also available directly from Inspired Energy, Inc. To purchase additional or replacement batteries, visit www.inspired-energy.com, or call toll free USA 1-888-5-INSPIRE (546-7747).

Working with Batteries

Battery Specifications

NOTE

Regarding the battery charger and conditioner:

- Install the instrument so that the ON / OFF switch is readily identifiable and is easily reached by the operator. The ON / OFF switch and the detachable power cord are the instrument disconnecting devices. They disconnect the mains circuits from the mains supply before other parts of the instrument. Alternatively, an externally installed switch or circuit breaker (which is readily identifiable and is easily reached by the operator) may be used as a disconnecting device.
 - Install the instrument so that the detachable power cord is readily identifiable and is easily reached by the operator. The detachable power cord is the instrument disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the instrument. The front panel switch is only a standby switch and is not a LINE switch. Alternatively, an externally installed switch or circuit breaker (which is readily identifiable and is easily reached by the operator) may be used as a disconnecting device.
-

Battery Current Drain

When in the Off mode the test set draws ~45 mA of current when the batteries) are left installed, and ~70 mA when in Standby mode.

The test set with a single battery loses ~18% of its battery charge per day in Off mode and ~28% per day in Standby mode. The following table shows how long a test set can be in Standby or Off modes until the battery is providing enough current to operate the test set.

Number of Batteries	Battery Capacity in Standby Mode	Battery Capacity in Off Mode
1	3.5 days	5.4 days
2	6.9 days	10.8 days

[“Adjustment, Maintenance, or Repair of the Base Station Test Set” on page 572](#)

[“Returning your Base Station Test Set for Service” on page 573](#)

[“Preparing the Agilent E7495A/B for Shipping” on page 573](#)

Adjustment, Maintenance, or Repair of the Base Station Test Set

Any adjustment, maintenance, or repair of the E7495A/B Base Station Test Set must be performed by qualified personnel. Contact your customer engineer through your local Agilent Technologies Service Center. You may contact Agilent through the Internet or by telephone. For contact information refer to “[Contacting Agilent Technologies](#)” on page 53.

NOTE

For specific test set packing instructions, refer to “[Returning your Base Station Test Set for Service](#)” on page 573.

Returning your Base Station Test Set for Service

The instructions in this section explain how to properly package the system for return to Agilent Technologies.

NOTE

Please notify Agilent Technologies before returning your system for service. Any special arrangements for the system can be discussed at this time. This will help Agilent Technologies repair and return your system as quickly as possible.

Warranty

If the system is still under warranty or is covered by an Agilent Technologies maintenance contract, it will be repaired under the terms of the warranty or contract. If the system is no longer under warranty or is not covered by an Agilent Technologies maintenance plan, Agilent Technologies will notify you of the cost of the repair after examining the unit.

When a system is returned to Agilent Technologies for servicing, it must be adequately packaged (see [“Preparing the Agilent E7495A/B for Shipping” on page 573](#)) and have a complete description of the failure symptoms attached.

When describing the failure, please be as specific as possible about the nature of the problem. Include copies of additional failure information (such as receiver or computer failure settings, data related to system failure, and error messages) along with the system being returned.

Preparing the Agilent E7495A/B for Shipping

CAUTION

Cover electrical connectors to protect sensitive components from electrostatic damage. Test set damage can result from using packaging materials other than the original materials. Never use styrene pellets as packaging material. They do not adequately cushion the system or prevent it from shifting in the carton. They may also cause system damage by generating static electricity.

Returning the Test Set for Service

Returning your Base Station Test Set for Service

Step	Notes
1 Write a complete description of the failure and attach it to the system.	<p>Include any specific performance details related to the problem. The following information should be returned with the system:</p> <ul style="list-style-type: none"><li>• Type of service required<li>• Date system was returned for repair<li>• Description of the problem:<ul style="list-style-type: none"><li>• Whether problem is constant or intermittent<li>• Whether system is temperature-sensitive<li>• Whether system is vibration sensitive<li>• System settings required to reproduce the problem<li>• Error Code<li>• Performance data<li>• Company Name and return address<li>• Name and phone number of technical contact person<li>• Model number of returned system<li>• Full serial number of returned system<li>• List of any accessories returned with the system
2 Caution: Cover all front and rear panel connectors that were originally covered when you first received the system.	
3 Pack the system in the original shipping containers. Original materials are available through Agilent Technologies office. See step 4 for more information.	

Step	Notes
4 Wrap the system in anti-static plastic to reduce the possibility of damage caused by electrostatic discharge.	<p>For systems weighing less than 54 kg (120 lbs.), use a double-walled, corrugated cardboard carton of 159 kg (350 lbs.) test strength.</p> <p>The carton must be large enough to allow 3 to 4 inches on all sides of the system for packing material, and strong enough to accommodate the weight of the system.</p> <p>Surround the equipment with 3 to 4 inches of packing material, to protect the system and prevent it from moving in the carton. If packing foam is not available, the best alternative is S.D-240 Air Cap™ from Sealed Air Corporation (Commerce, California 90001). Air Cap looks like a plastic sheet filled with air bubbles. Use the pink (anti-static) Air Cap to reduce static electrical damage. Wrapping the system several times in this material will protect the system and prevent it from moving in the carton.</p>
5 Seal the carton with strong nylon adhesive tape and mark it “FRAGILE, HANDLE WITH CARE”.	
6 Retain copies of all shipping papers.	

Returning the Test Set for Service
Returning your Base Station Test Set for Service

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